CHAPTER 30

ICE AND RAIN PROTECTION

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1. Table of Contents Microfilm -- Instructions For Use

   A. This microfilm contains the Table of Contents (TOC), and maintenance manual information for all DC-8 60 Series aircraft customers except Air Canada whose TOC reflects a combined 50/60 Series Maintenance Manual. For information on a specific aircraft, refer to TOC for the owner or lessee of that aircraft.

   B. Each Table of Contents page has the Chapter, CODE, and Page number in the bottom outside corner of the page. The CODE number determines the customer; for example, CODE 1 is United Air Lines, CODE 2 Delta Air Lines and so on. The Table of Contents lists the Aircraft Identification page (if applicable), Alphabetical Index, and Chapter, Section, Subject matter with applicable aircraft CODE. Adjacent to the CODE, the aircraft effectivity is listed.

   C. Aircraft are identified on the Table of Contents either by Effectivity Code Number, Fleet Number, Registration Number, or Factory Serial Number. The Factory Serial Number is used only when the Fleet Number or Registration Number is not available.

   D. Table of Contents for all customers are listed immediately following these instructions. Where applicable, the Aircraft Identification page is inserted immediately following the TOC. This Aircraft Identification page contains the name of the customer or lessee, Manufacturing Series, Factory Serial Number, Effectivity Code or Fleet Number, and Registration Number. The Aircraft Identification page will have a customer CODE as described above.

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Customer Title	Airline Code	Table of Contents Code
United Air Lines, Inc.	UAL	1
Eastern Air Lines, Inc.	EAL	2
Swiss Air Transport Company, Ltd. Scandinavian Airlines System	SWA/SAS	3
Delta Air Lines, Inc.	DLT	4
National Airlines, Inc.	NAL	5
Braniff Airways, Inc. (was PAC)	BNF	6
Air Canada (was TCA)	AC	7
Alitalia-Linee Aeree Italiane	ALI	8
KLM-Royal Dutch Airlines	KLM	9
Trans International Airlines	TIA	10
Trans Caribbean Airways, Inc.	TRC	11
Canadian Pacific Air Lines, Ltd.	CPA	12
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Universal Airlines, Inc.	UNI	16
The Flying Tiger Line, Inc.	FTL	17
Capital Airways, Inc.	CAP	18
Iberia, Lineas Aereas de Espana, S.A.	IBR	19
Airlift International, Inc. (includes LYD)	ALF	20
Overseas National Airways, Inc.	ONA	21
Seaboard World Airlines, Inc.	SEA	22
Venezolana Internacional de Aviacion, S.A. (a/c included in KLM Contents)	VIA	23
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AIRPLANE IDENTIFICATION

SWISS AIR TRANSPORT COMPANY, LTD.

SCANDINAVIAN AIRLINES, SYSTEM

Manufacturing Series	Factory Serial Number	SWA/SAS Effectivity Code	Registration Letters	Customer
DC-8-62	45905	55	SE-DBF	SAS
DC-8-62	45906	56	OY-KTD	SAS
DC-8-62	45822	57	LN-MOO	SAS
DC-8-62	45823	58	SE-DBE	SAS
DC-8-62	45921	59	SE-DBG	SAS
DC-8-62	45919	60	HB-IDE	SWA
DC-8-62	45920	61	HB-IDF	SWA
DC-8-62	45925	62	HB-IDG	SWA
DC-8-62CF	45922	63	OY-KTE	SAS
DC-8-62CF	45984	64	HB-IDH	SWA
DC-8-62	46077	65	HB-IDI	SWA
DC-8-62CF	46078	66	HB-IDK	SWA
DC-8-62	46134	67	HB-IDL	SWA
DC-8-62	46102	68	LN-MOG	SAS
DC-8-62CF	46129	69	SE-DBI	SAS
DC-8-63	45923	70	LN-MOU	SAS
DC-8-63	45924	71	SE-DBH	SAS

Manufacturing Series	Factory Serial Number	SWA/SAS Effectivity Code	Registration Letters	Customer
DC-8-63	46041	72	OY-KTF	SAS
DC-8-63	46054	73	LN-MOY	SAS
DC-8-63	46136	74	SE-DBK	SAS
DC-8-63	46163	75	SE-DBL	SAS
DC-8-63PF	46074	76		SWA
DC-8-62	46131	77	LN-MOW	SAS
DC-8-62AF	46150	78	LN-MOC	SAS

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AIRPLANE IDENTIFICATION

DELTA AIR LINES, INC.

Manufacturing Series	Factory Serial Number	Fleet Number	Registration Number
DC-8-61	45907	861	N822E
DC-8-61	45914	862	N823E
DC-8-61	45915	863	N824E
DC-8-61	45944	864	N825E
DC-8-61	45979	865	N826E
DC-8-61	46014	866	N1300L
DC-8-61	46018	867	N1301L
DC-8-61	46029	868	N1302L
DC-8-61	46030	869	N1303L
DC-8-61	46048	870	N1304L
DC-8-61	46072	871	N1305L
DC-8-61	46055	872	N1306L
DC-8-61	46056	873	N1307L

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AIRPLANE IDENTIFICATION

AIR CANADA

Manufacturing Series	Factory Serial Number	Fleet Number	Registration Number	Manufacturing Series	Factory Serial Number	Fleet Number	Registration Series
DC-8-40	45442	801	CF-TJA	DC-8-50	45933	820	CF-TIH
DC-8-40	45443	802	CF-TJB	DC-8-50	45934	821	CF-TII
DC-8-40	45444	803	CF-TJC	DC-8-50	45962	822	CF-TIJ
DC-8-40	45445	804	CF-TJD	DC-8-61	45890	860	CF-TJT
DC-8-40	45565	805	CF-TJE	DC-8-61	45891	861	CF-TJU
DC-8-40	45566	806	CF-TJF	DC-8-61	45892	862	CF-TJV
DC-8-40	45609	807	CF-TJG	DC-8-61	45893	863	CF-TJW
DC-8-40	45610	808	CF-TJH	DC-8-61	45963	864	CF-TJX
DC-8-40	45611	809	CF-TJI	DC-8-61	4596[illegible]	865	CF-TJY
DC-8-40	45612	810	CF-TJJ	DC-8-61	45980	866	CF-TJZ
DC-3-40	45638	811	CF-TJK	DC-8-63	46033	867	CF-TIK
DC-8-50F	45640	812	CF-TJL	DC-8-63	46034	868	CF-TIL
DC-8-50F	45653	813	CF-TJM	DC-8-63	46035	869	CF-TIM
DC-8-50F	45654	[illegible]	CF-TJN	DC-8-63	46036	870	CF-[illegible]IN
DC-8-50F	45655	815	CF-TJO	DC-8-63	46070	871	CF-TIO
DC-8-50F	45679	816	CF-TJP	DC-8-63	46100	872	CF-TIP
DC-8-50F	45686	817	CF-TJQ	DC-8-63	46123	873	CF-TIQ
DC-8-50F	45860	818	CF-TJR	DC-8-63	46124	874	CF-TIR
DC-8-50F	45861	819	CF-TJS	DC-8-63	46125	875	CF-TIS

Manufacturing Series	Factory Serial Number	Fleet Number	Registration Number	Manufacturing Series	Factory Serial Number	Fleet Number	Registration Series
DC-8-63	46113	876	CF-TIU				
DC-8-63	46126	877	CF-TIV				
DC-8-63	46114	878	CF-TIW				
DC-8-63	46115	879	CF-TIX				

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GENERAL - DESCRIPTION AND OPERATION

1. Description

A. Ice protection is provided by a deicing system to remove accumulated ice, and by anti-icing systems to prevent the formation of ice. The leading edges of the wings, including the wing leading edge slots, and the horizontal stabilizer are deiced. The fuselage nose scoops are anti-iced. For cowl and engine anti-icing, see Chapter 75. Hot air for deicing and anti-icing is supplied from the low-pressure pneumatic system. On all airplanes electrical anti-icing systems are provided for the windshields, stall warning lift transducer, and pitot tubes. Airplanes N8070U through N8099U and N8966U through N8975U have an electrical anti-icing system for the water basin drain masts. Airplanes N8070U through N8099U have an electrical anti-icing system for the engine inlet pressure P_t2 probes. Airplanes N8966U through N8975U have an electrical anti-icing system for the waste water service panels.

B. The controls and indicating lights for the deicing system are grouped on the systems engineer's control panel. The pneumatic and electrical anti-icing systems are controlled and monitored from the overhead switch panel.

C. The airfoil deicing system is set in operation by placing the airfoil deicing switch in either the timer 1 or timer 2 position.

D. The scoops anti-icing system is operated from the overhead switch panel by placing the control switch in the anti-ice position.

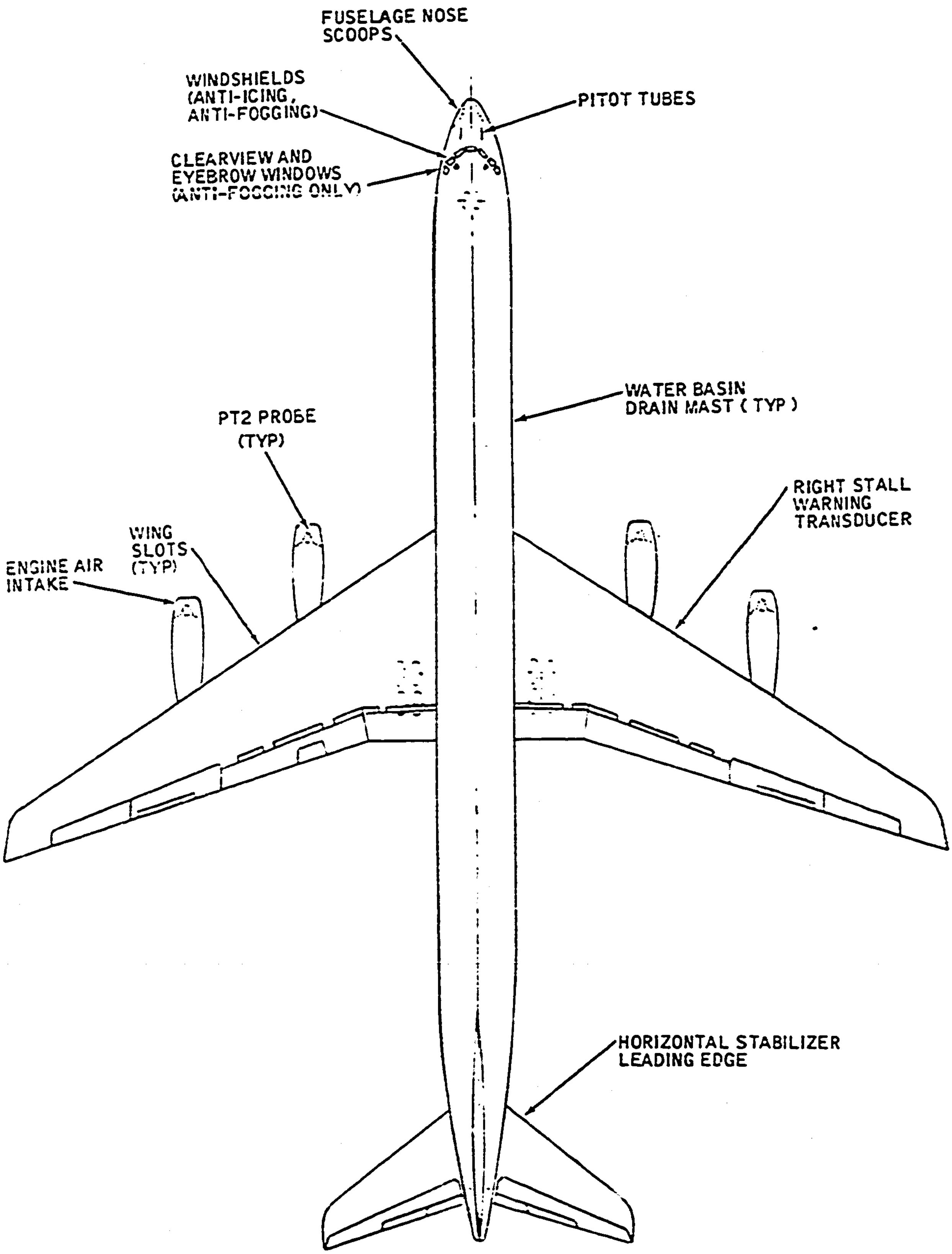
E. The anti-icing heaters and ammeter selector switch, when placed in one of the operating positions, energizes all pitot and static port heaters and the heaters in the stall warning lift transducer.

F. On airplanes N8070U through N8099U the engine inlet pressure (P_t2) probe anti-icing system controls ice accumulation around the P_t2 probes. The system consists of a heating element in each P_t2 probe. The probes are energized whenever the airplane electrical buses are energized.

G. The windshield and window heat control system is controlled by the windshield heat control switch located on the overhead switch panel.

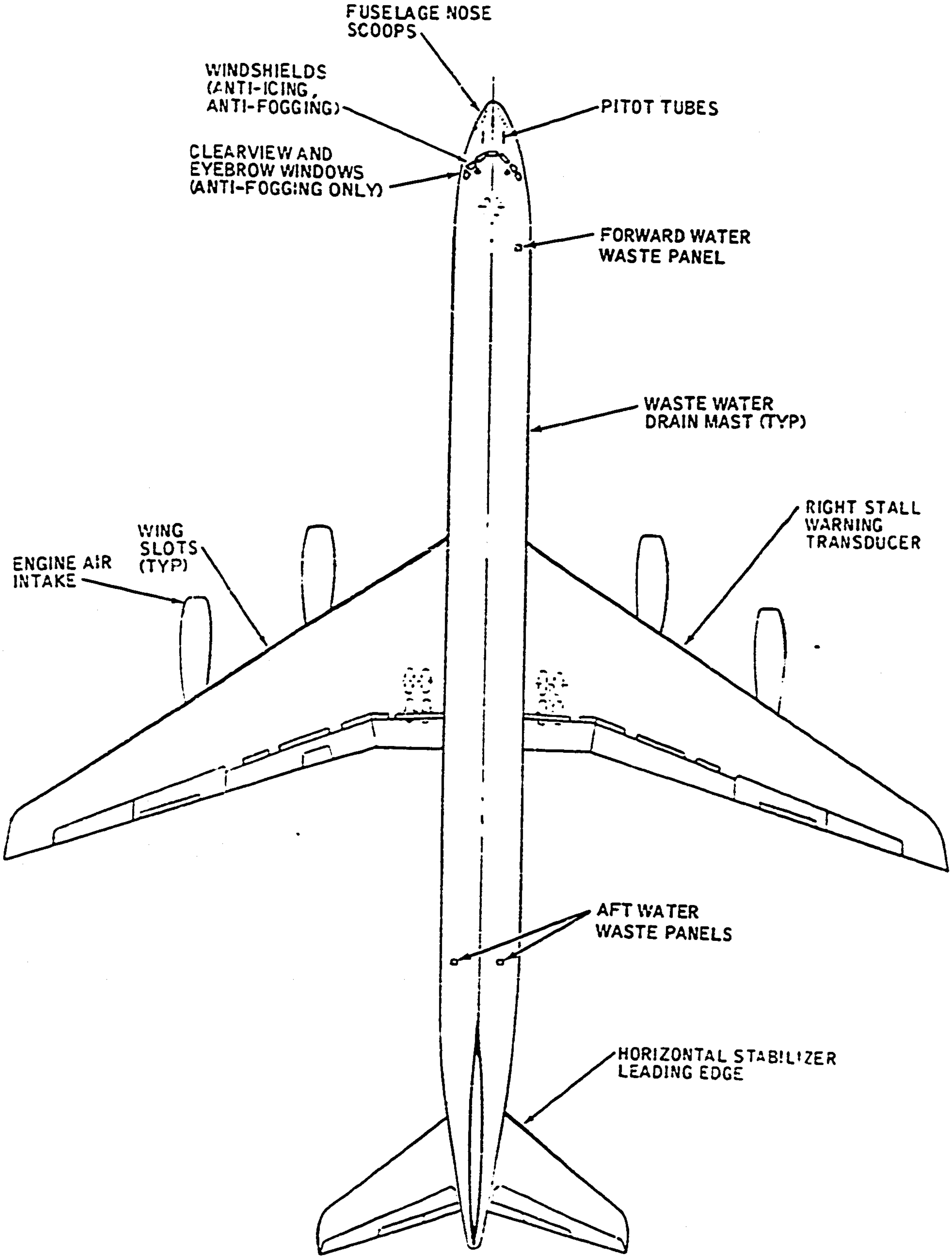
H. Air from the pneumatic system is used for windshield rain removal. The flow of air is controlled by cable-actuated valves, operated by levers located in the captain's and first officer's consoles.

I. On all airplanes except N8072U through N8074U liquid rain repellent system facilitates the removal of rain from the windshields. The system is controlled by momentary pushbuttons located on the flight compartment glareshield. The repellent is stored in a pressurized container located on the outside of the first officer's console.

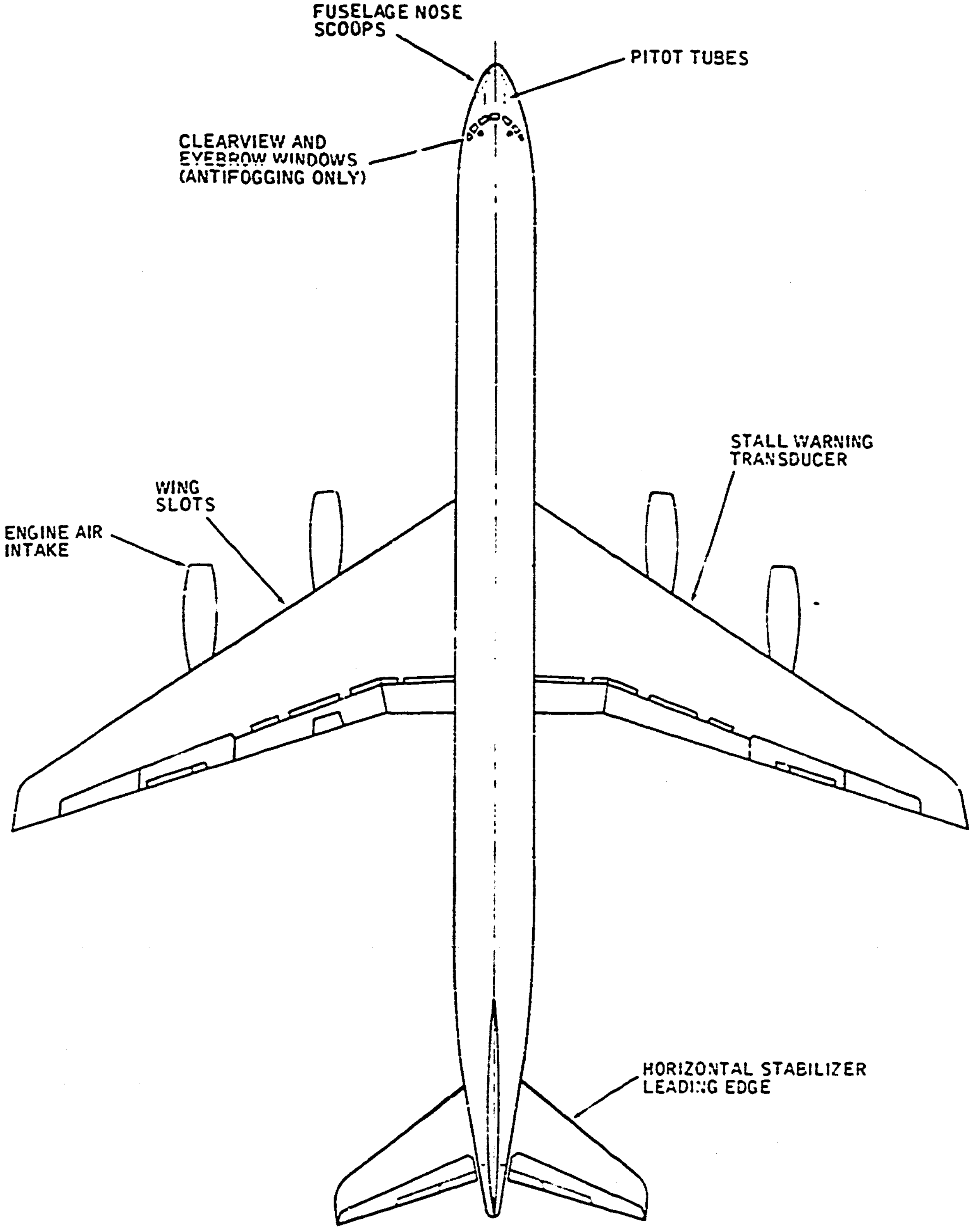


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Ice Protection Areas
(Airplanes N8070U - N8099U)
Figure 1 (Sheet 1)

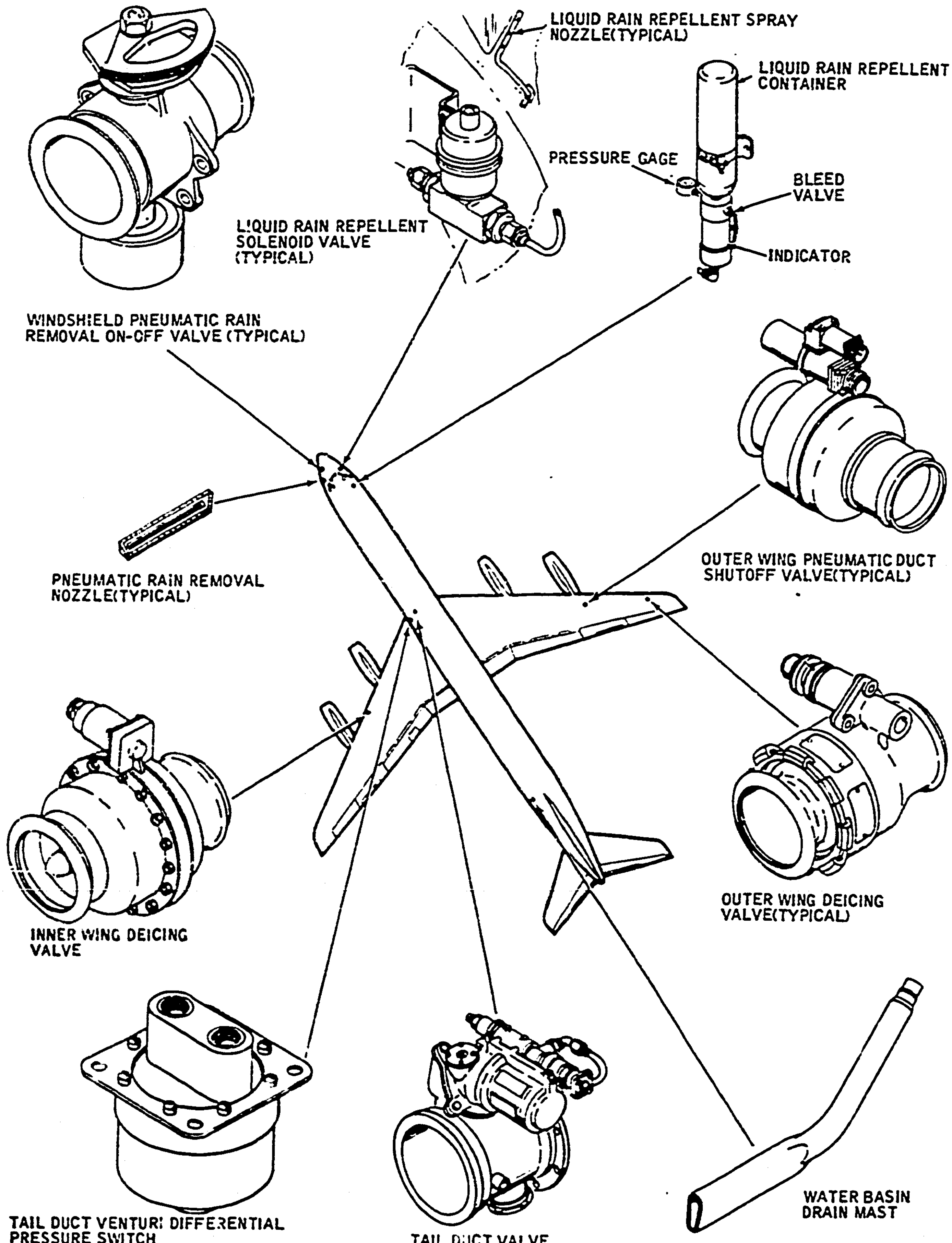


Ice Protection Areas
(Airplanes N8966U - N8975U)
Figure 1 (Sheet 2)

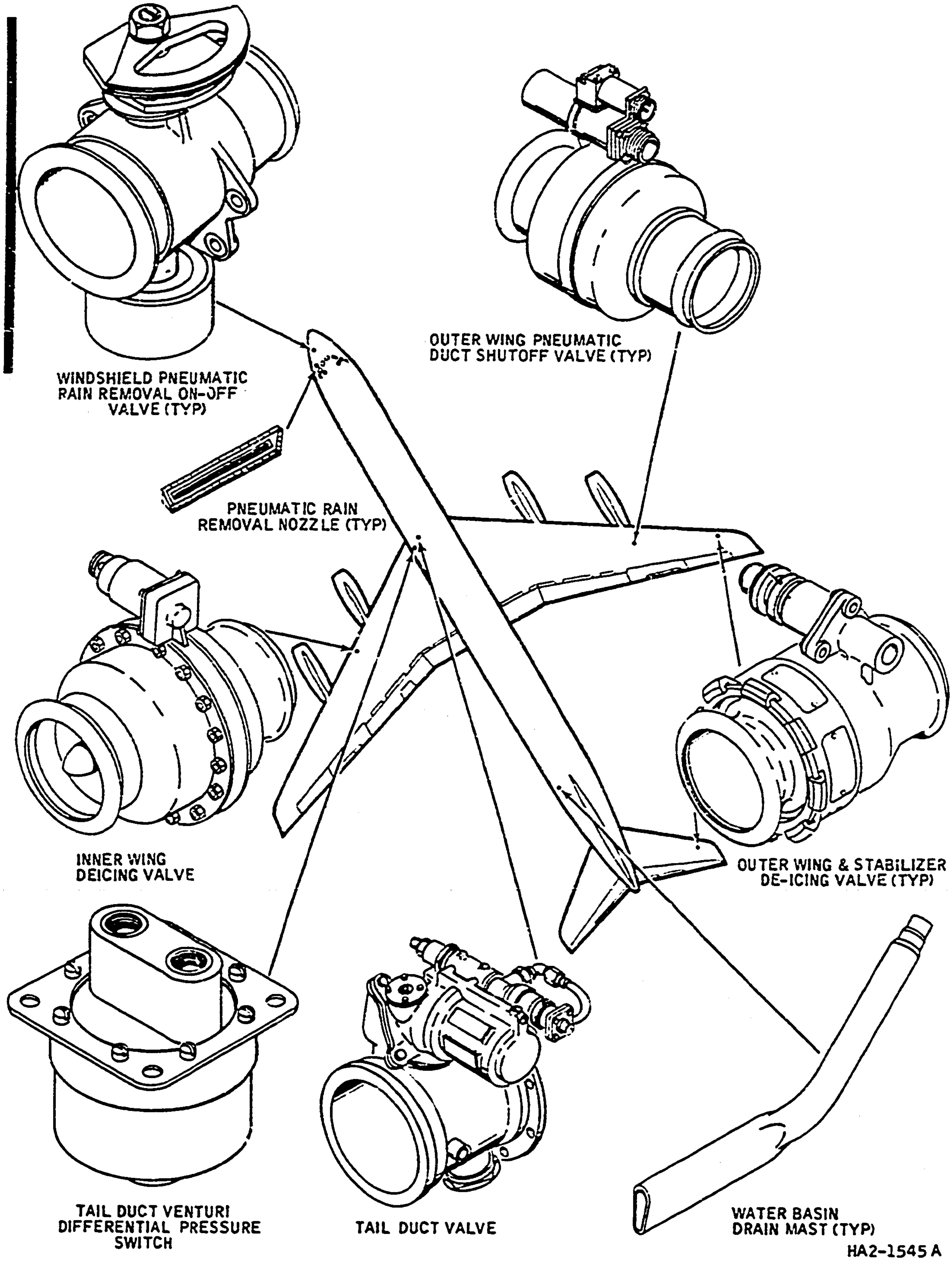


HA2-5828

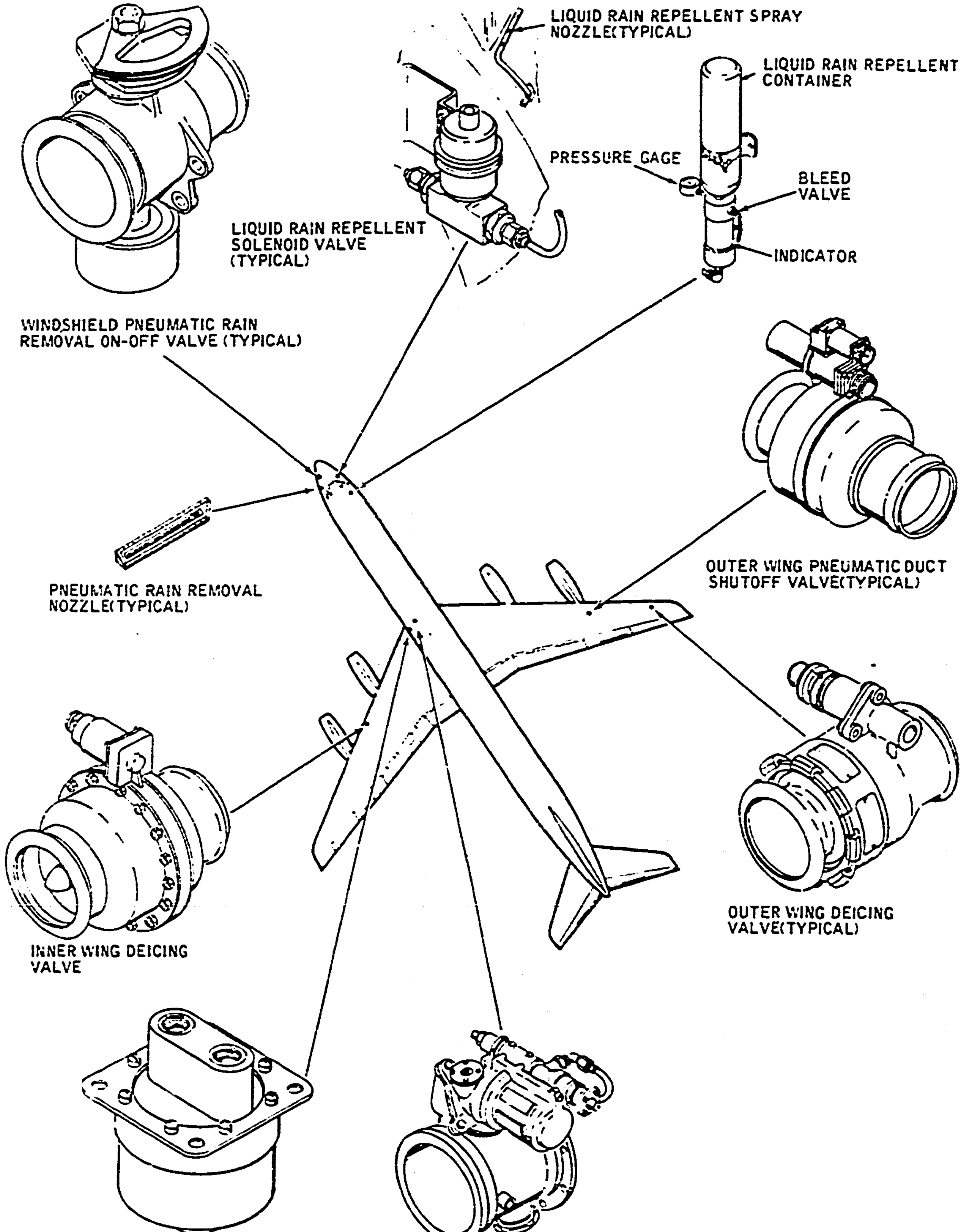
Ice Protection Areas
(Airplanes N8717U, N8724U, N8731U)
Figure 1 (Sheet 3)



Ice and Rain Protection System
(Airplanes N8070U, N8071U, N8075U - N8099U, N8966U - N8975U)
Figure 2 (Sheet 1)



Ice and Rain Protection System
(Airplanes N8072U - N8074U)
Figure 2 (Sheet 2)



Ice and Rain Protection System
(Airplanes N8717U, N8724U, N8731U)
Figure 2 (Sheet 3)

GENERAL - DESCRIPTION AND OPERATION

1. Description

A. Ice protection is provided by a deicing system to remove accumulated ice, and by anti-icing systems to prevent the formation of ice. The leading edges of the wings, including the wing leading edge slots, and the horizontal stabilizer are deiced. The fuselage nose scoops are anti-iced. For cowl and engine anti-icing, see Chapter 75. Hot air for deicing and anti-icing is supplied from the low-pressure pneumatic system. Electrical anti-icing systems are provided for the windshields, engine inlet pressure P_{t2} probes, stall warning lift transducers, pitot tubes, and water basin drain masts.

B. The controls and indicating lights for the deicing system are grouped on the systems engineer's control panel. The pneumatic and electrical anti-icing systems are controlled and monitored from the overhead switch panel.

C. The airfoil deicing system is set in operation by placing the airfoil deicing switch in either the timer 1 or timer 2 position.

D. The scoops anti-icing system is operated from the overhead switch panel by placing the control switch in the anti-ice position.

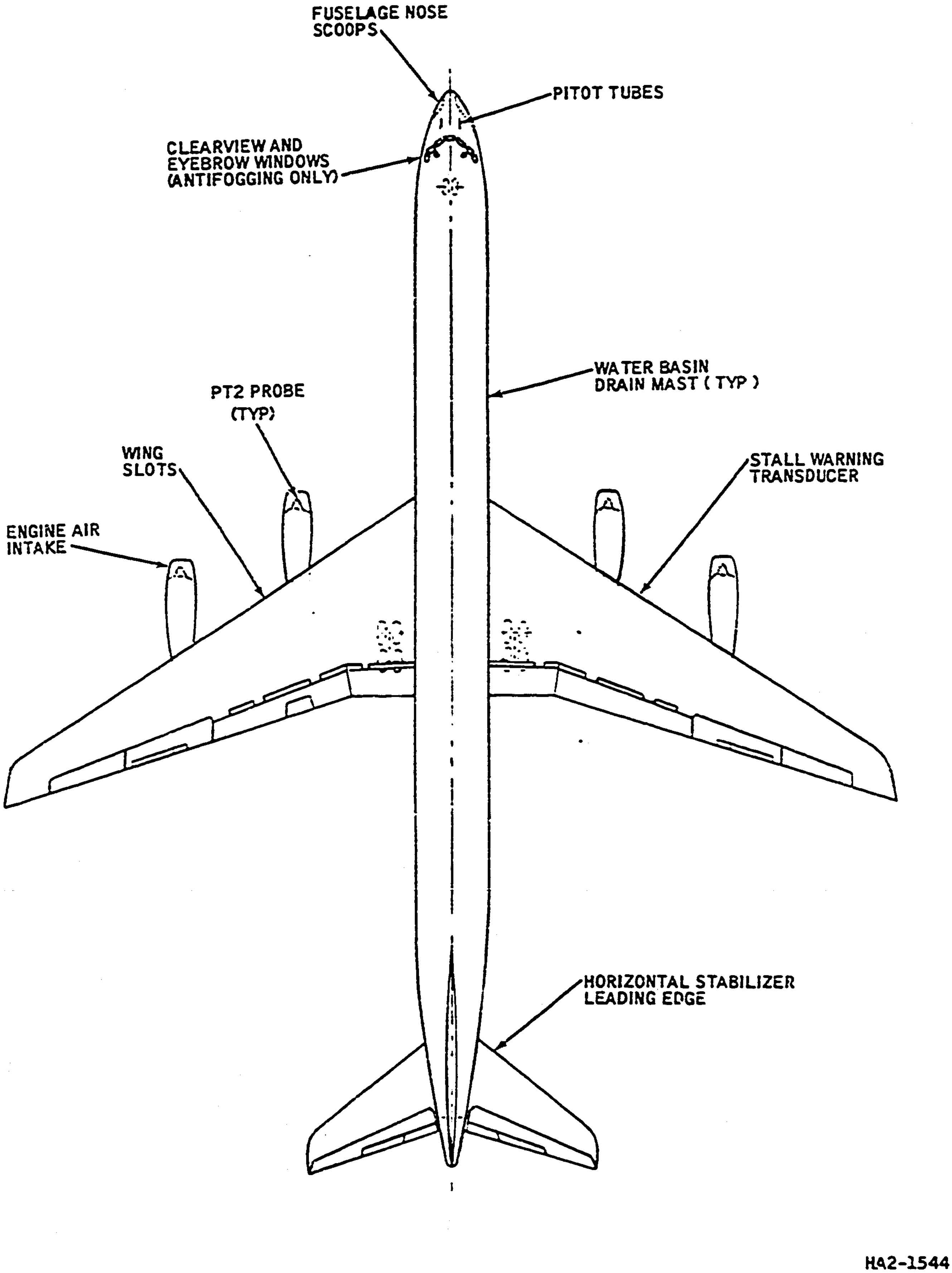
E. The anti-icing heaters and ammeter selector switch, when placed in one of the operating positions, energizes all pitot and static port heaters and the heaters in the stall warning lift transducer.

F. The engine inlet pressure (P_{t2}) probe anti-icing system controls ice accumulation around the P_{t2} probes. The system consists of a heating element in each P_{t2} probe. The probes are energized whenever the airplane electrical buses are energized.

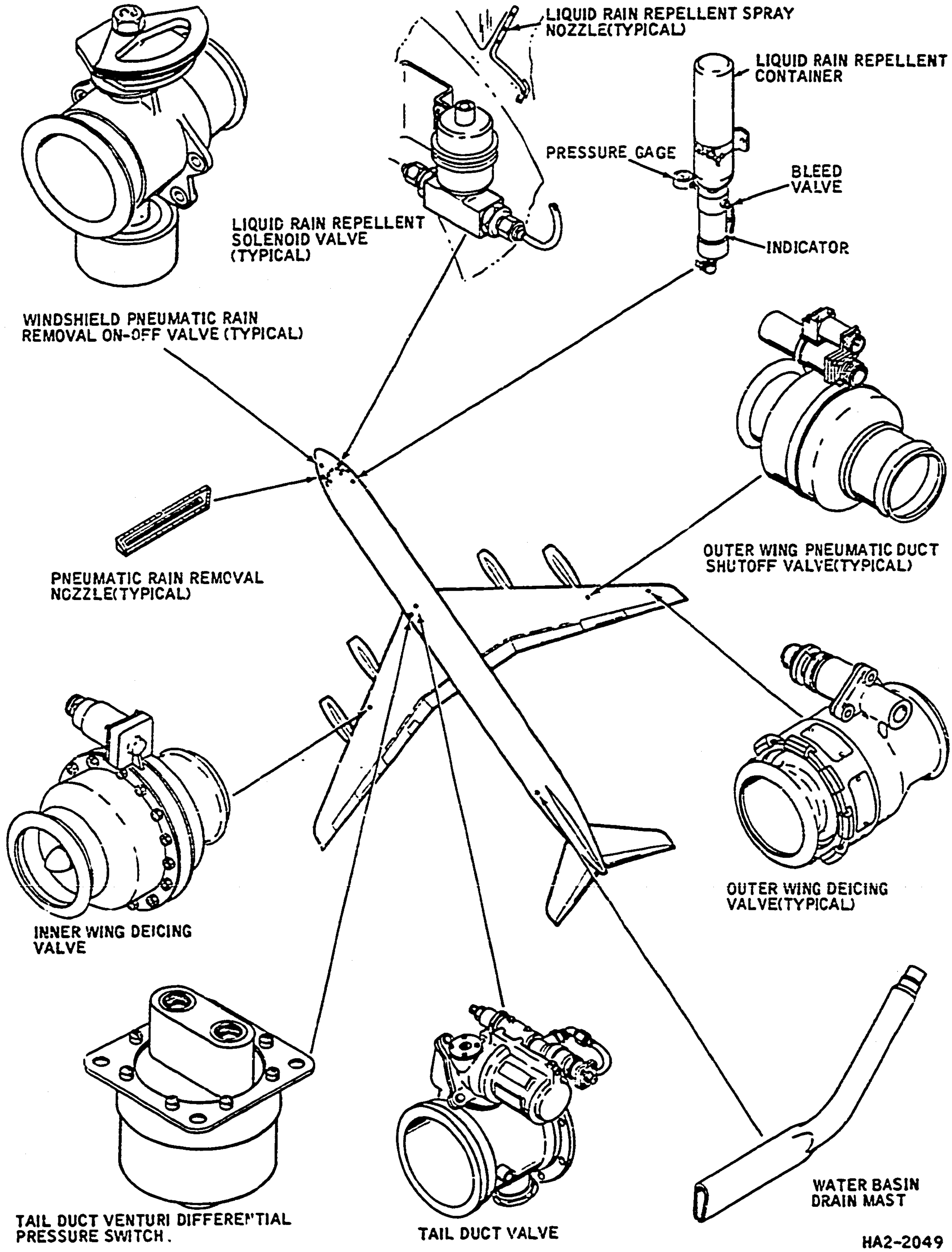
G. The windshield and window heat control system is controlled by the windshield heat control switch located on the overhead switch panel.

H. Air from the pneumatic system is used for windshield rain removal. The flow of air is controlled by cable-actuated valves, operated by levers located in the captain's and first officer's consoles.

I. A liquid rain repellant system facilitates the removal of rain from the windshields. The system is controlled by momentary pushbuttons located on the flight compartment glareshield. The repellant is stored in a pressurized container locat[illegible] on the outside of the first officer's console.



Ice Protection Areas
Figure 1



Ice and Rain Protection System
Figure 2

GENERAL - DESCRIPTION AND OPERATION

1. Description

A. Ice protection is provided by a deicing system to remove accumulated ice, and by anti-icing systems to prevent the formation of ice. The leading edges of the wings, including the wing leading edge slots, and the horizontal stabilizer are deiced. The fuselage nose scoops are anti-iced. For cowl and engine anti-icing, see Chapter 75. Hot air for deicing and anti-icing is supplied from the low-pressure pneumatic system. Electrical anti-icing systems are provided for the windshields, engine inlet pressure P_{t2} probes, stall warning lift transducers, pitot tubes, and water basic drain masts.

B. The controls and indicating lights for the deicing system are grouped on the systems engineer's control panel. The pneumatic and electrical anti-icing systems are controlled and monitored from the overhead switch panel.

C. The airfoil deicing system is set in operation by placing the airfoil deicing switch in either the timer 1 or timer 2 position.

D. The scoops anti-icing system is operated from the overhead switch panel by placing the control switch in the anti-ice position.

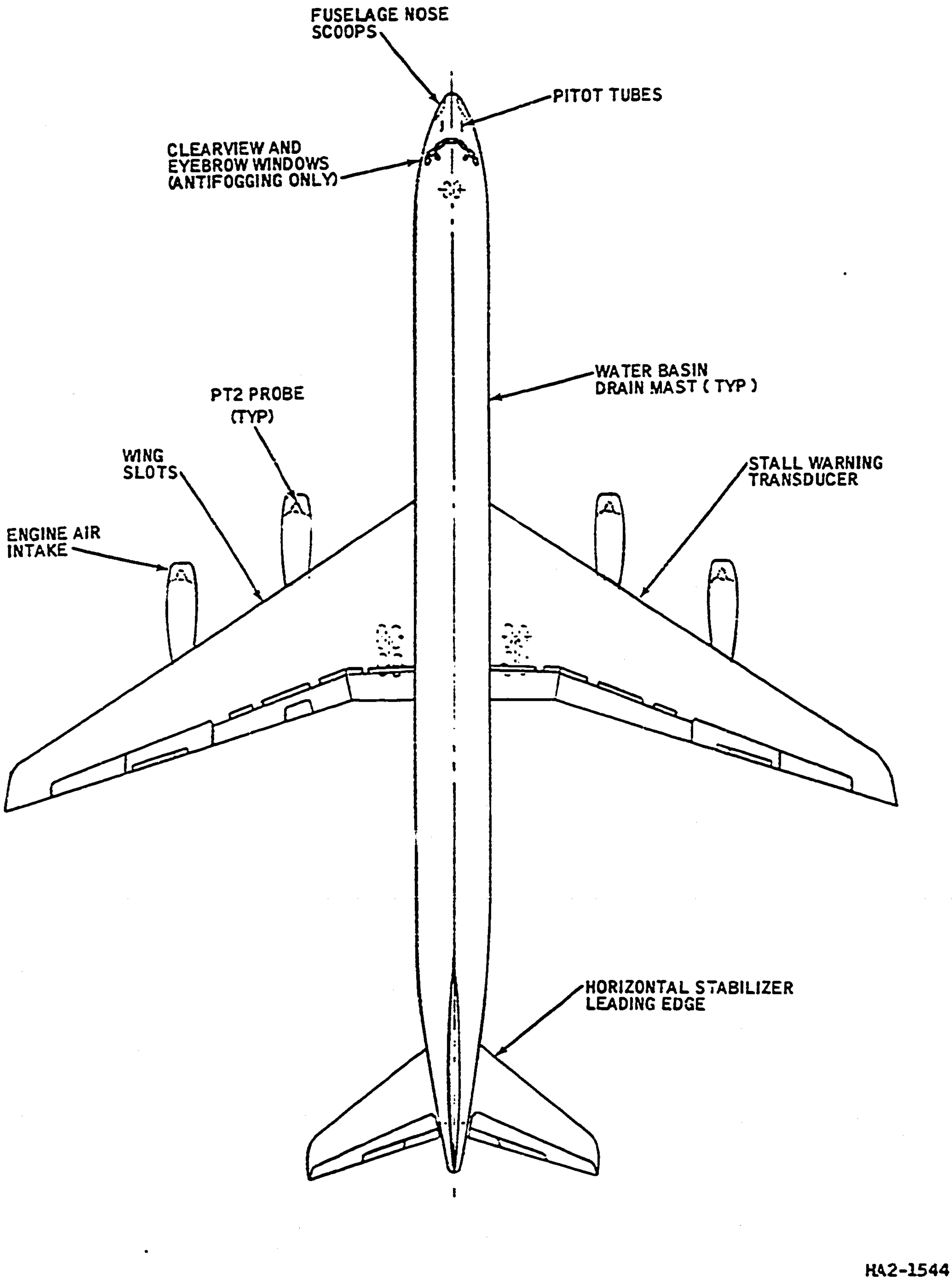
E. The anti-icing heaters and ammeter selector switch, when placed in one of the operating positions, energizes all pitot and static port heaters and the heaters in the stall warning lift transducer.

F. The engine inlet pressure (P_{t2}) probe anti-icing system controls ice accumulation around the P_{t2} probes. The system consists of a heating element in each P_{t2} probe. The probes are energized whenever the airplane electrical buses are energized.

G. The windshield and window heat control system is controlled by the windshield heat control switch located on the overhead switch panel.

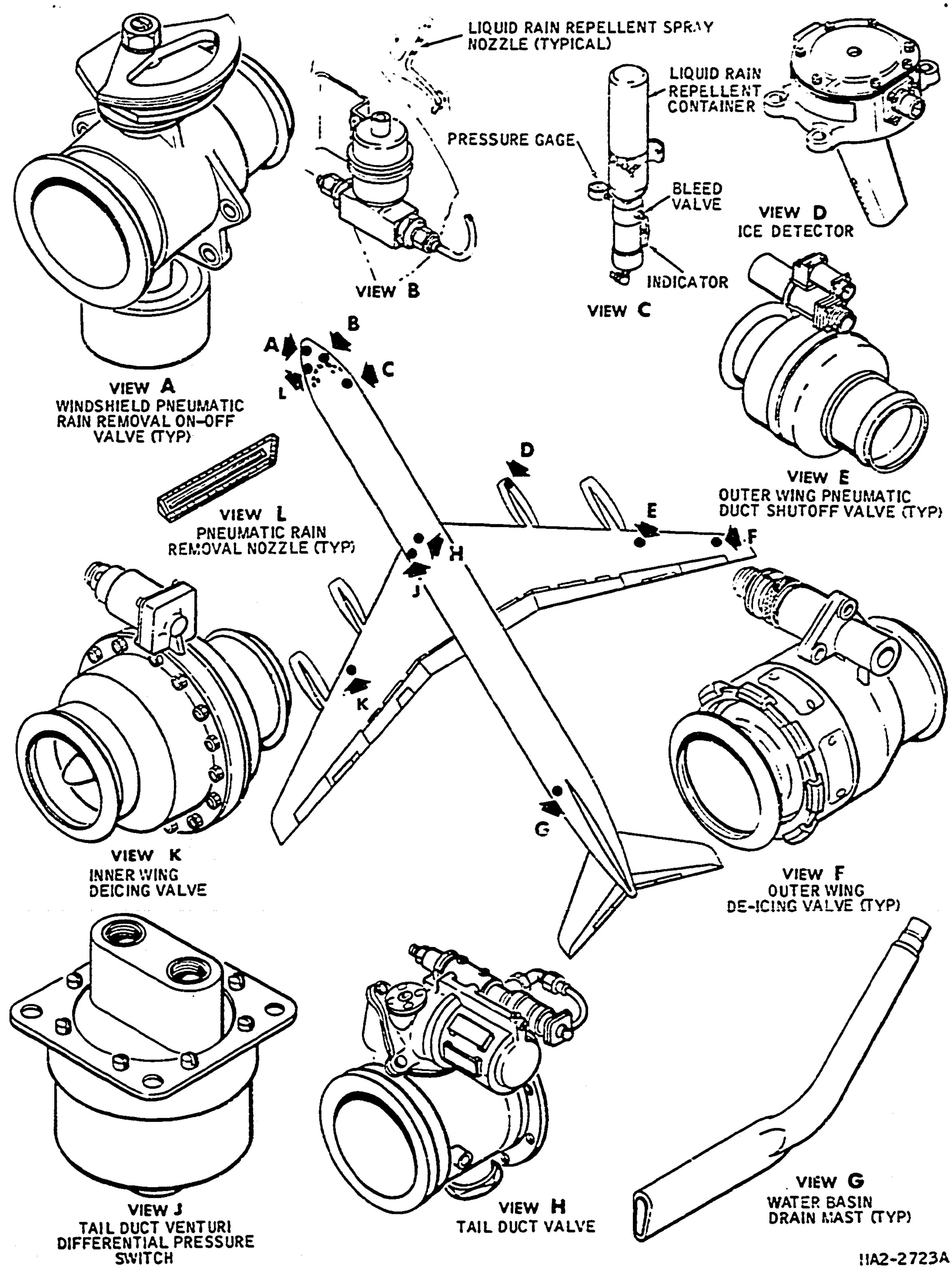
H. Air from the pneumatic system is used for windshield rain removal. The flow of air is controlled by cable-actuated valves, operated by levers located in the captain's and first officer's consoles.

I. A liquid rain repellant system facilitates the removal of rain from the windshields. The system is controlled by momentary pushbuttons located on the flight compartment glareshield. The repellant is stored in a pressurized container located on the outside of the first officer's console.



Ice Protection Areas
Figure 1

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Ice and Rain Protection System
Figure 2

J. An ice detection system is provided to give visual indication of the formation of ice on the surfaces of the airplane. Two ice detectors are located, one each, in the engine nacelle cowling of engine numbers 2 and 3. Two sets of indicating lights are located in the flight compartment, one set for the pilots and one for the systems engineer.

GENERAL - DESCRIPTION AND OPERATION

1. Description

A. Ice protection is provided by a deicing system to remove accumulated ice, and by anti-icing systems to prevent the formation of ice. The leading edges of the wings, including the wing leading edge slots, and the horizontal stabilizer are deiced. The fuselage nose scoops are anti-iced. For cowl and engine anti-icing, see Chapter 75. Hot air for deicing and anti-icing is supplied from the low-pressure pneumatic system. Electrical anti-icing systems are provided for the windshields, stall warning lift transducer, pitot tubes, and water basin drain masts.

B. The controls and indicating lights for the deicing system are grouped on the systems engineer's control panel. The pneumatic and electrical anti-icing systems are controlled and monitored from the overhead switch panel.

C. The airfoil deicing system is set in operation by placing the airfoil deicing switch in either the timer 1 or timer 2 position.

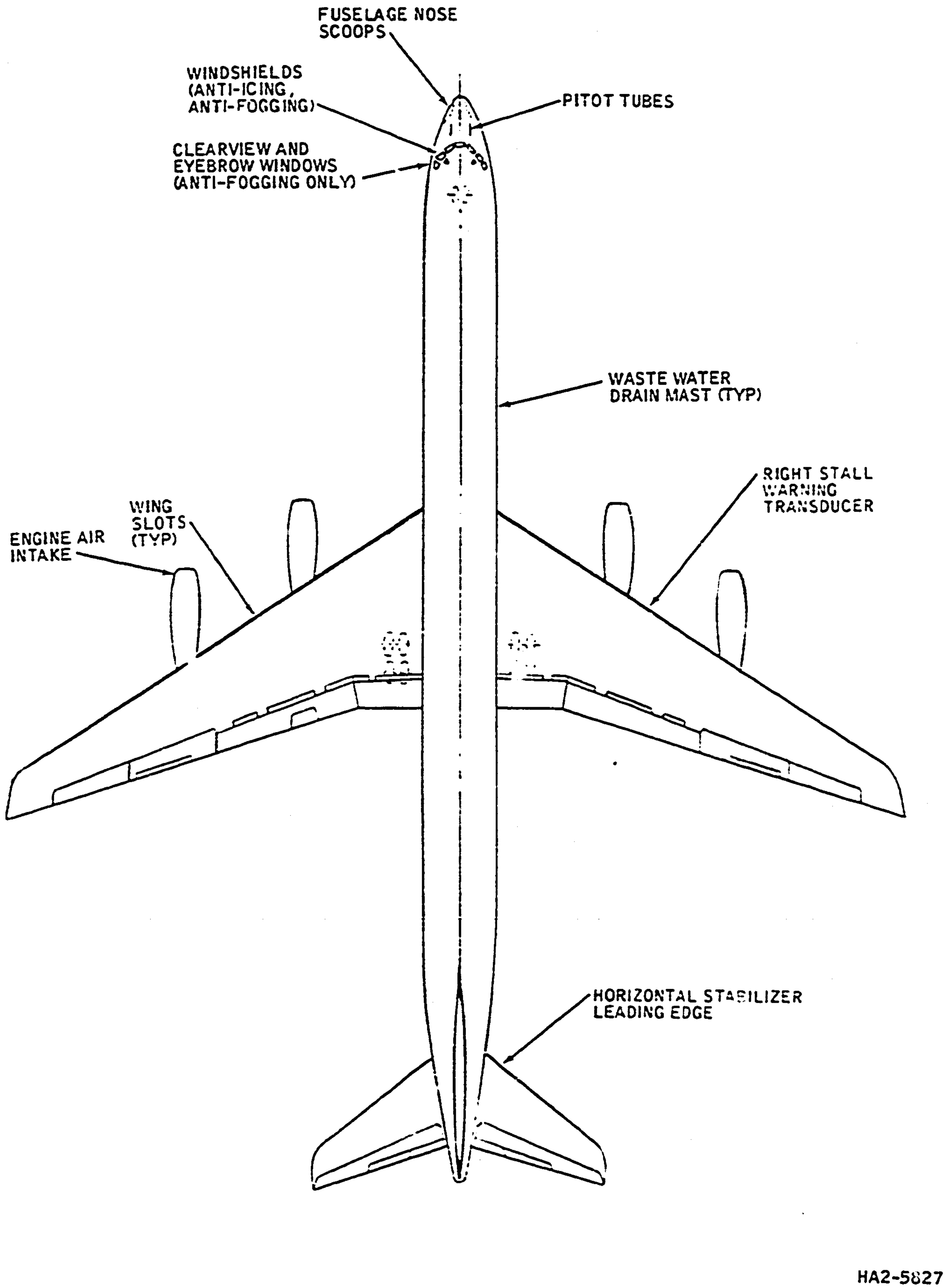
D. The scoops anti-icing system is operated from the overhead switch panel by placing the control switch in the anti-ice position.

E. The anti-icing heaters switch, when placed in the on position, energizes all pitot and static port heaters and the heaters in the stall warning lift transducer.

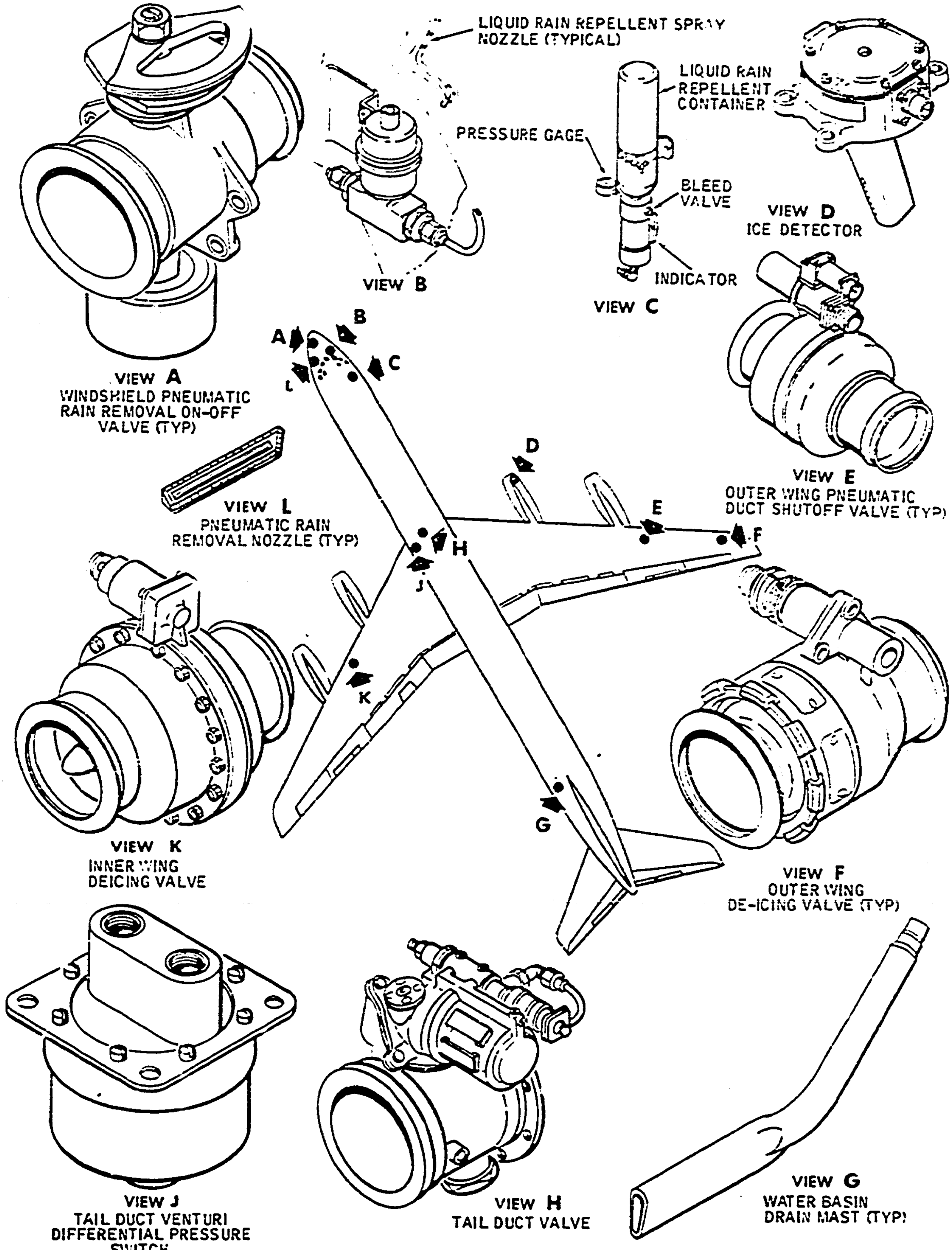
F. The windshield and window heat control system is controlled by the windshield heat control switch located on the overhead switch panel.

G. Air from the pneumatic system is used for windshield rain removal. The flow of air is controlled by cable-actuated valves, operated by levers located in the captain's and first officer's consoles.

H. A liquid rain repellent system facilitates the removal of rain from the windshields. The system is controlled by momentary pushbuttons located on the flight compartment glareshield. The repellent is stored in a pressurized container located on the outside of the first officer's console.



Ice Protection Areas
Figure 1



Ice and Rain Protection System
Figure 2

GENERAL - DESCRIPTION AND OPERATION

1. Description

A. Ice protection is provided by a deicing system to remove accumulated ice, and by anti-icing systems to prevent the formation of ice. The leading edges of the wings, including the wing leading edge slots, and the horizontal stabilizer are deiced. The fuselage nose scoops and on airplanes 801 through 811 the wing scoops are anti-iced. For cowl and engine anti-icing, see Chapter 75. Hot air for deicing and anti-icing is supplied from the low-pressure pneumatic system. Electrical anti-icing systems are provided for the windshields, pitot tubes, stall warning lift transducer and on airplanes 812 through 822 the engine inlet pressure P_{t2} probes.

B. The controls and indicating lights for the deicing system are grouped on the main instrument panel. The pneumatic and electrical anti-icing systems are controlled and monitored from the overhead switch panel.

C. The airfoil deicing system is set in operation by placing the airfoil deicing switch in either the timer 1 or timer 2 position.

D. The scoops anti-icing system is operated from the overhead switch panel by placing the control switch in the anti-ice position.

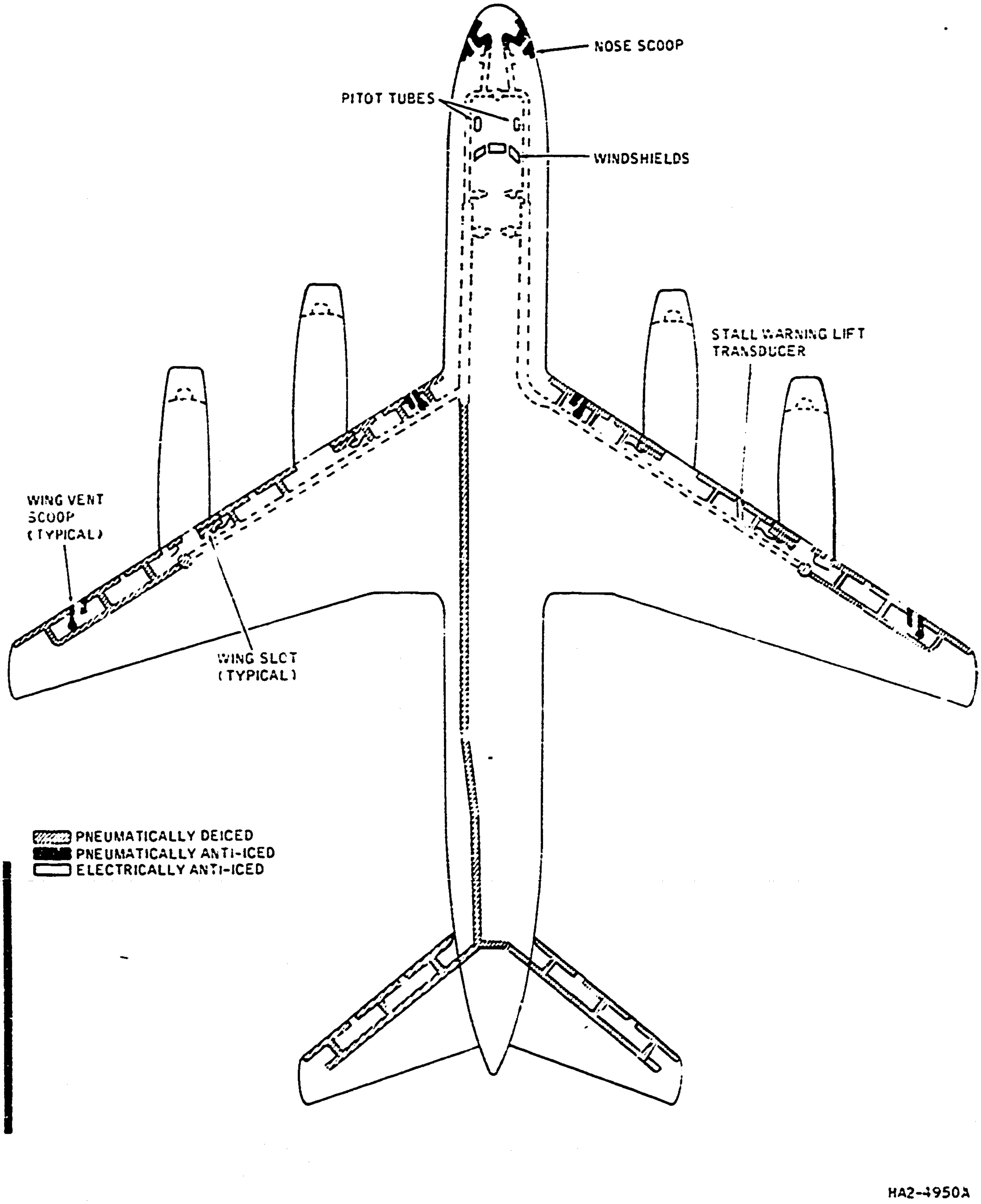
E. The anti-icing switch, when placed in the on position, energizes all pitot and static port heaters and the heaters in the stall warning lift transducer.

F. An ice detection system is provided to give visual indication of the formation of ice on the surfaces of the airplane. Two ice detectors are located, one each, in the engine nacelle cowling of engine numbers 2 and 3. Two sets of indicating lights are located on the main instrument panel.

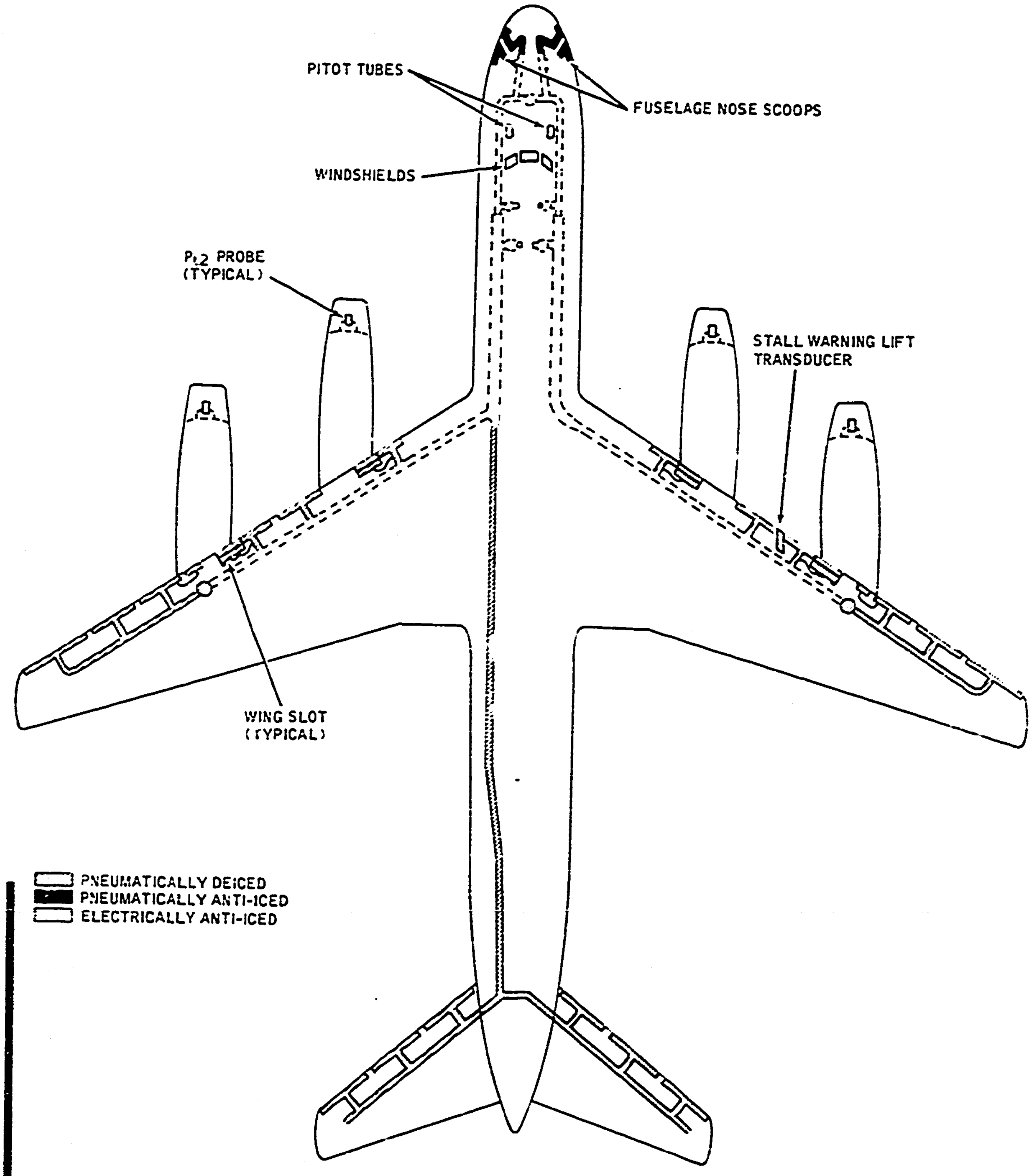
G. The windshield and window heat control system is controlled by the windshield heat control switch located on the overhead switch panel.

H. Air from the pneumatic system is used for windshield rain removal. The flow of air is controlled by cable-actuated valves, operated by levers located in the captain's and first officer's consoles.

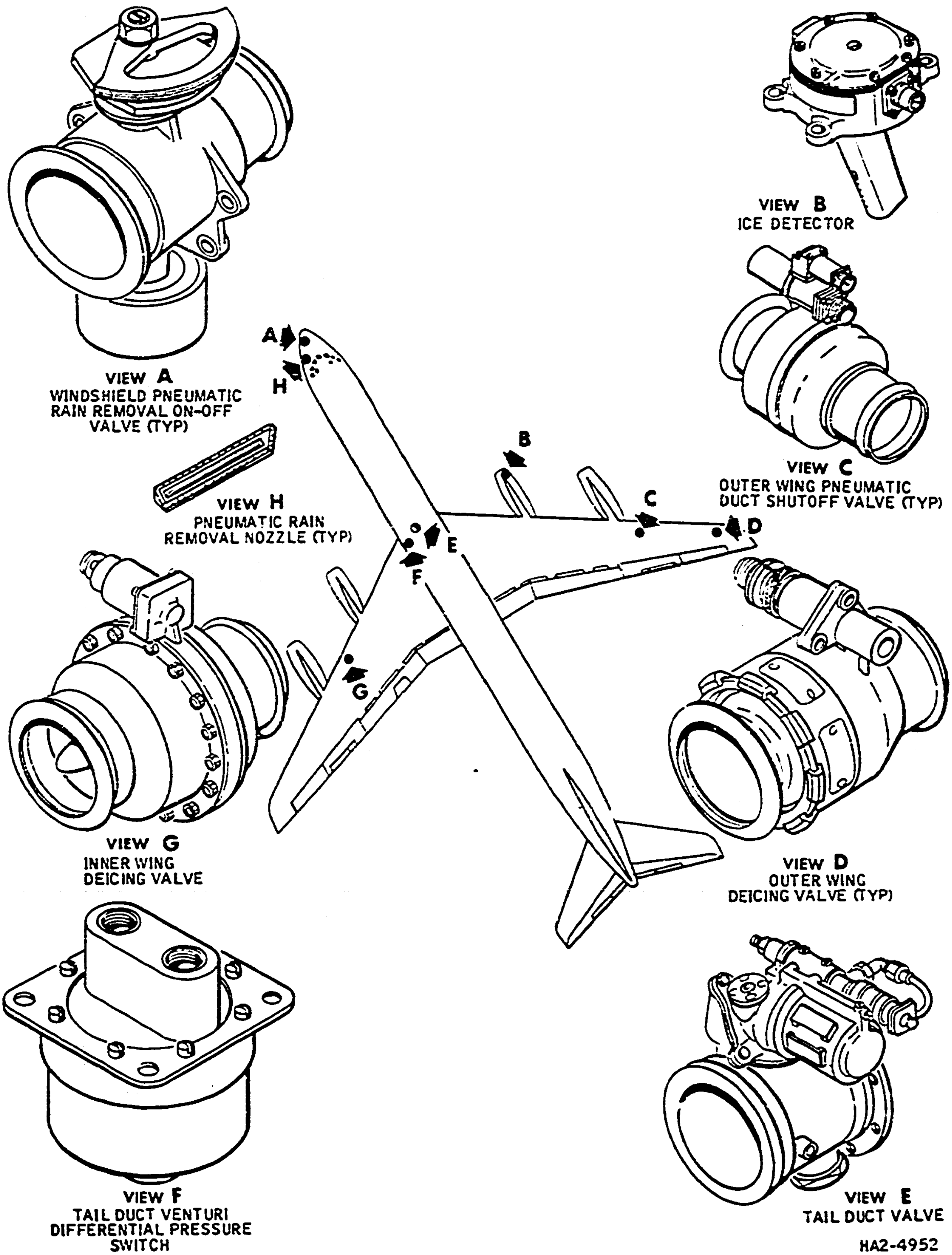
I. On airplanes 812 through 822 the engine inlet pressure (P_{t2}) probe anti-icing system controls ice accumulation around the P_{t2} probes. The system consists of a heating element in each P_{t2} probe. The probes are energized whenever the airplane electrical buses are energized.



Airplane Deicing and Anti-Icing
(Airplanes 801-811)
Figure 1 (Sheet 1)



Airplane Deicing and Anti-Icing
(Airplanes 812-822)
Figure 1 (Sheet 2)



Ice and Rain Protection System
Figure 2

GENERAL - DESCRIPTION AND OPERATION

1. Description

A. Ice protection is provided by a deicing system to remove accumulated ice, and by anti-icing systems to prevent the formation of ice. The leading edges of the wings, including the wing leading edge slots, and the horizontal stabilizer are deiced. The fuselage nose scoops are anti-iced. For cowl and engine anti-icing, see Chapter 75. Hot air for deicing and anti-icing is supplied from the low-pressure pneumatic system. Electrical anti-icing systems are provided for the windshields, stall warning lift transducer, pitot tubes, water basin drain masts and on airplanes 860 through 866 the engine inlet pressure P_{t2} probes.

B. The controls and indicating lights for the deicing system are grouped on the main instrument panel. The pneumatic and electrical anti-icing systems are controlled and monitored from the overhead switch panel.

C. The airfoil deicing system is set in operation by placing the airfoil deicing switch in either the timer 1 or timer 2 position.

D. The scoops anti-icing system is operated from the overhead switch panel by placing the control switch in the anti-ice position.

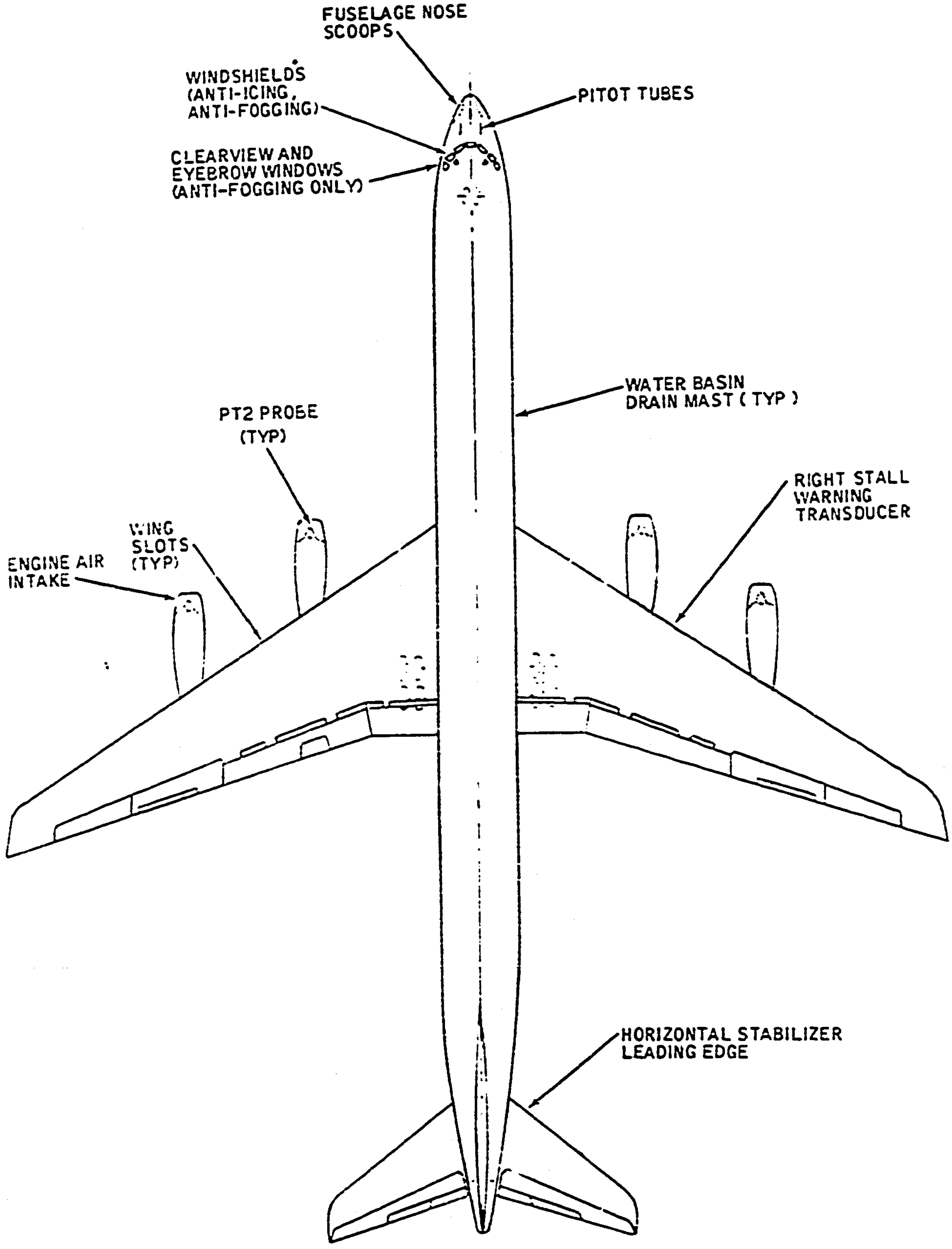
E. The anti-icing switch, when placed in the on position, energizes all pitot and static port heaters and the heaters in the stall warning lift transducer.

F. The windshield and window heat control system is controlled by the windshield heat control switch located on the overhead switch panel.

G. Air from the pneumatic system is used for windshield rain removal. The flow of air is controlled by cable-actuated valves, operated by levers located in the captain's and first officer's consoles.

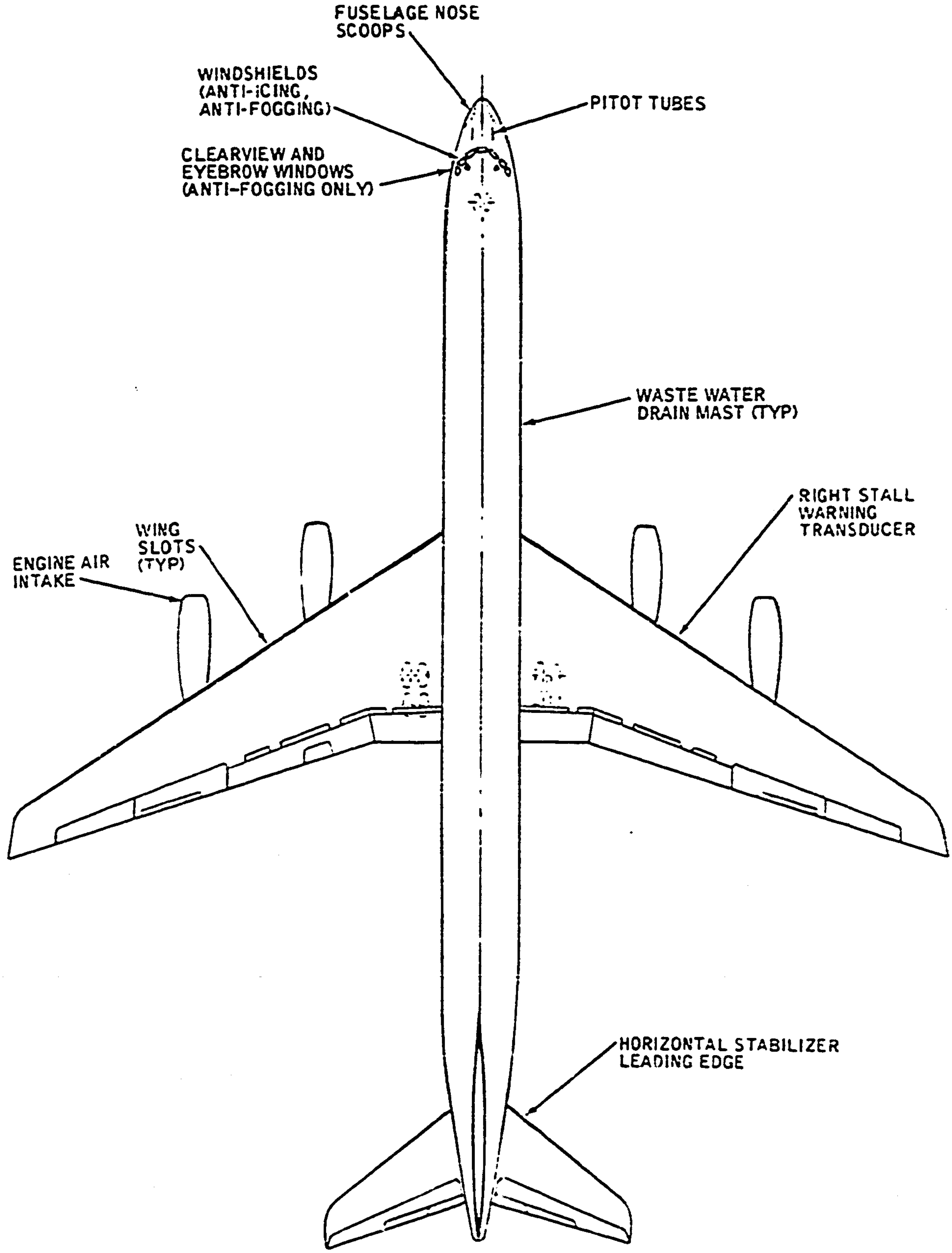
H. A liquid rain repellant system facilitates the removal of rain from the windshields. The system is controlled by momentary pushbuttons located on the flight compartment glareshield. The repellant is stored in a pressurized container located on the outside of the first officer's console.

I. On airplanes 860 through 866 the engine inlet pressure (P_{t2}) probe anti-icing system controls ice accumulation around the P_{t2} probes. The system consists of a heating element in each P_{t2} probe. The probes are energized whenever the airplane electrical buses are energized.



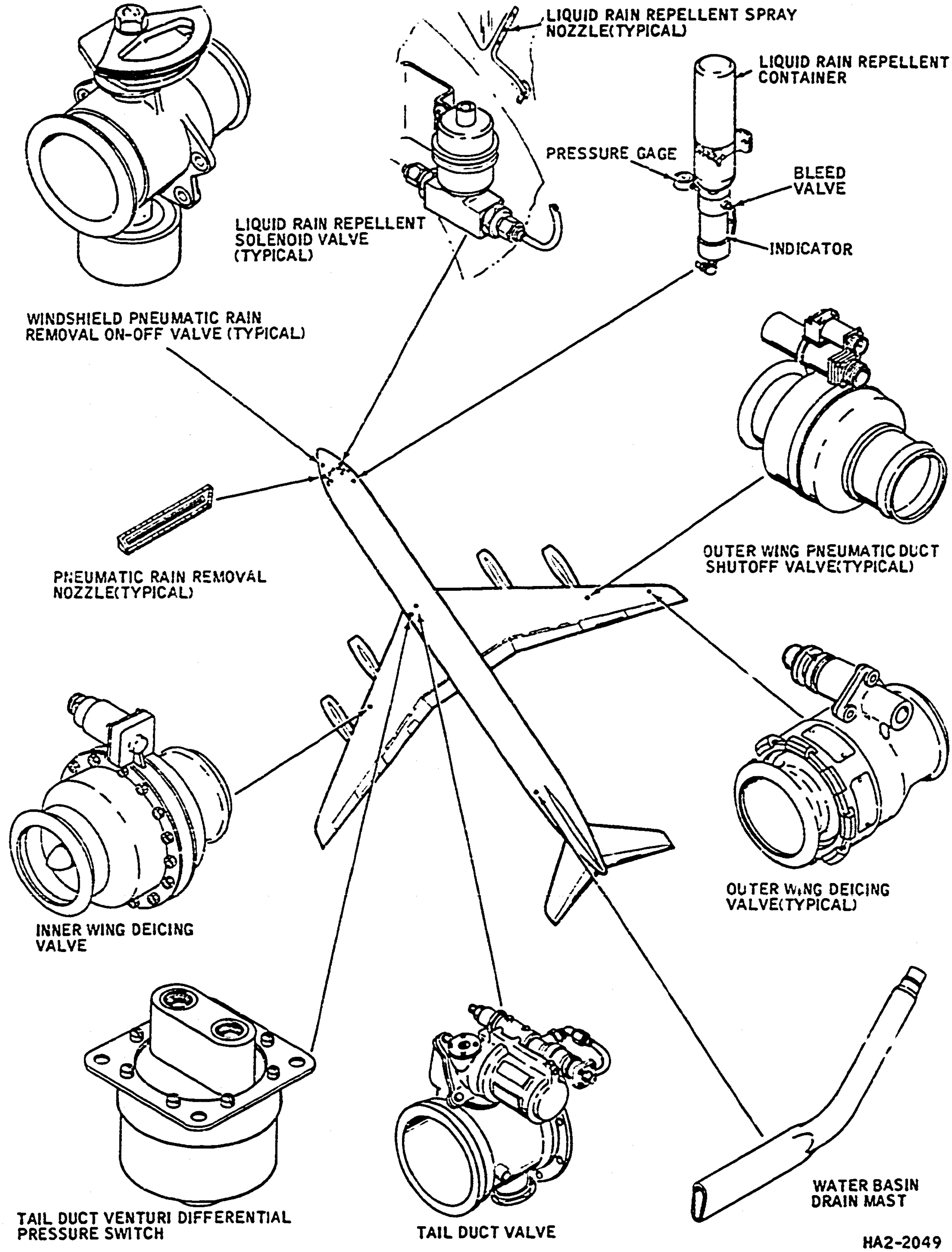
HA2-1544

Ice Protection Areas
(Airplanes 860-866)
Figure 1 (Sheet 1)



Ice Protection Areas
(Airplanes 867 and Subsequent)
Figure 1 (Sheet 2)

Printed in U.S.A.



Ice and Rain Protection System
Figure 2

GENERAL - DESCRIPTION AND OPERATION

1. Description

A. Ice protection is provided by a deicing system to remove accumulated ice, and by anti-icing systems to prevent the formation of ice. The leading edges of the wings, including the wing leading edge slots, and the horizontal stabilizer are deiced. The fuselage nose scoops are anti-iced. For cowl and engine anti-icing, see Chapter 75. Hot air for deicing and anti-icing is supplied from the low-pressure pneumatic system. Electrical anti-icing systems are provided for the windshields, stall warning lift transducer, pitot tubes, and water basin drain masts.

B. The controls and indicating lights for the deicing system are grouped on the systems engineer's control panel. The pneumatic and electrical anti-icing systems are controlled and monitored from the overhead switch panel.

C. The airfoil deicing system is set in operation by placing the airfoil deicing switch in either the timer 1 or timer 2 position.

D. The scoops anti-icing system is operated from the overhead switch panel by placing the control switch in the anti-ice position.

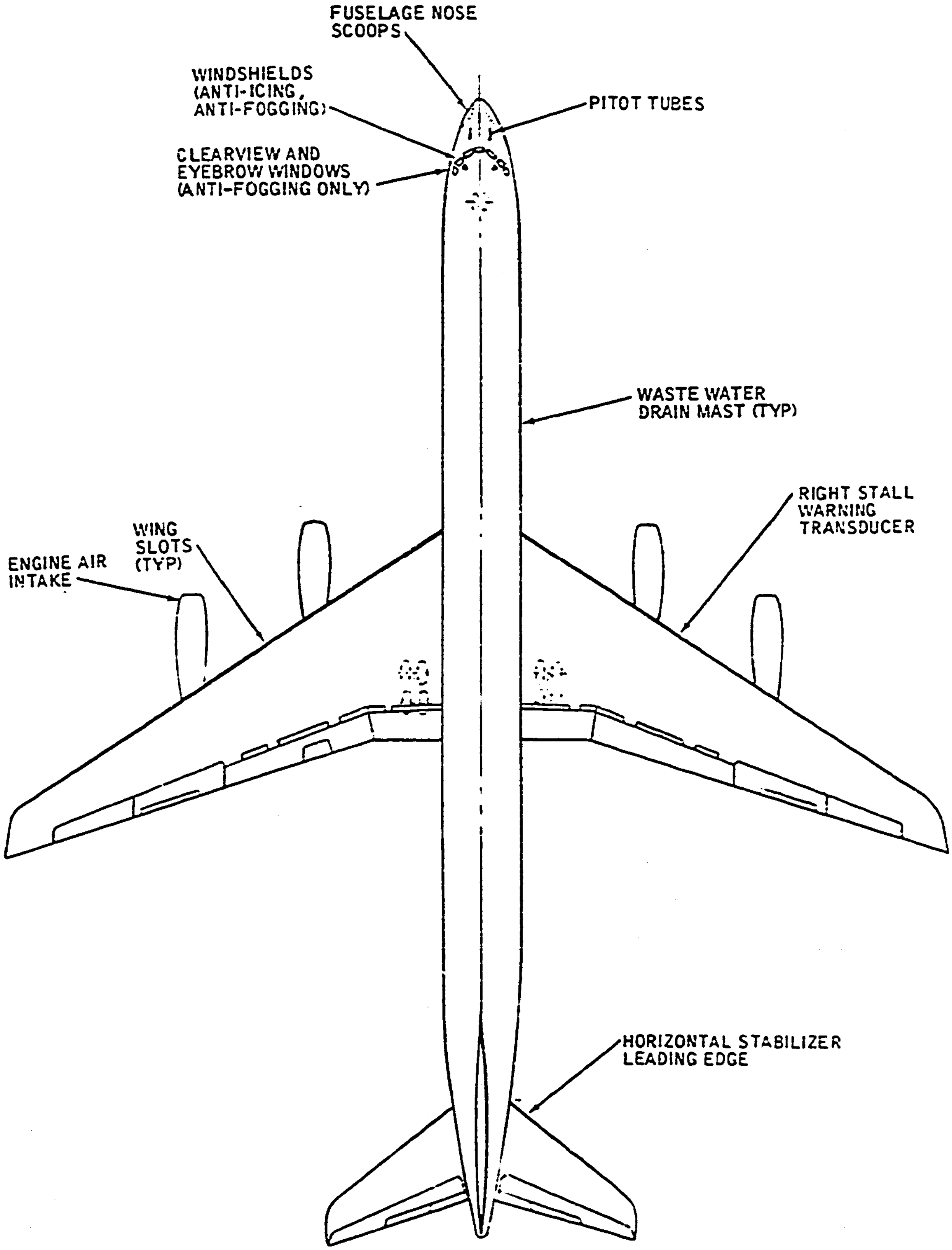
E. The anti-icing heaters and ammeter selector switch, when placed in one of the operating positions, energizes all pitot and static port heaters and the heaters in the left and right stall warning lift transducers.

F. The windshield and window heat control system is controlled by the windshield heat control switch located on the overhead switch panel.

G. Air from the pneumatic system is used for windshield rain removal. The flow of air is controlled by cable-actuated valves, operated by levers located in the captain's and first officer's consoles.

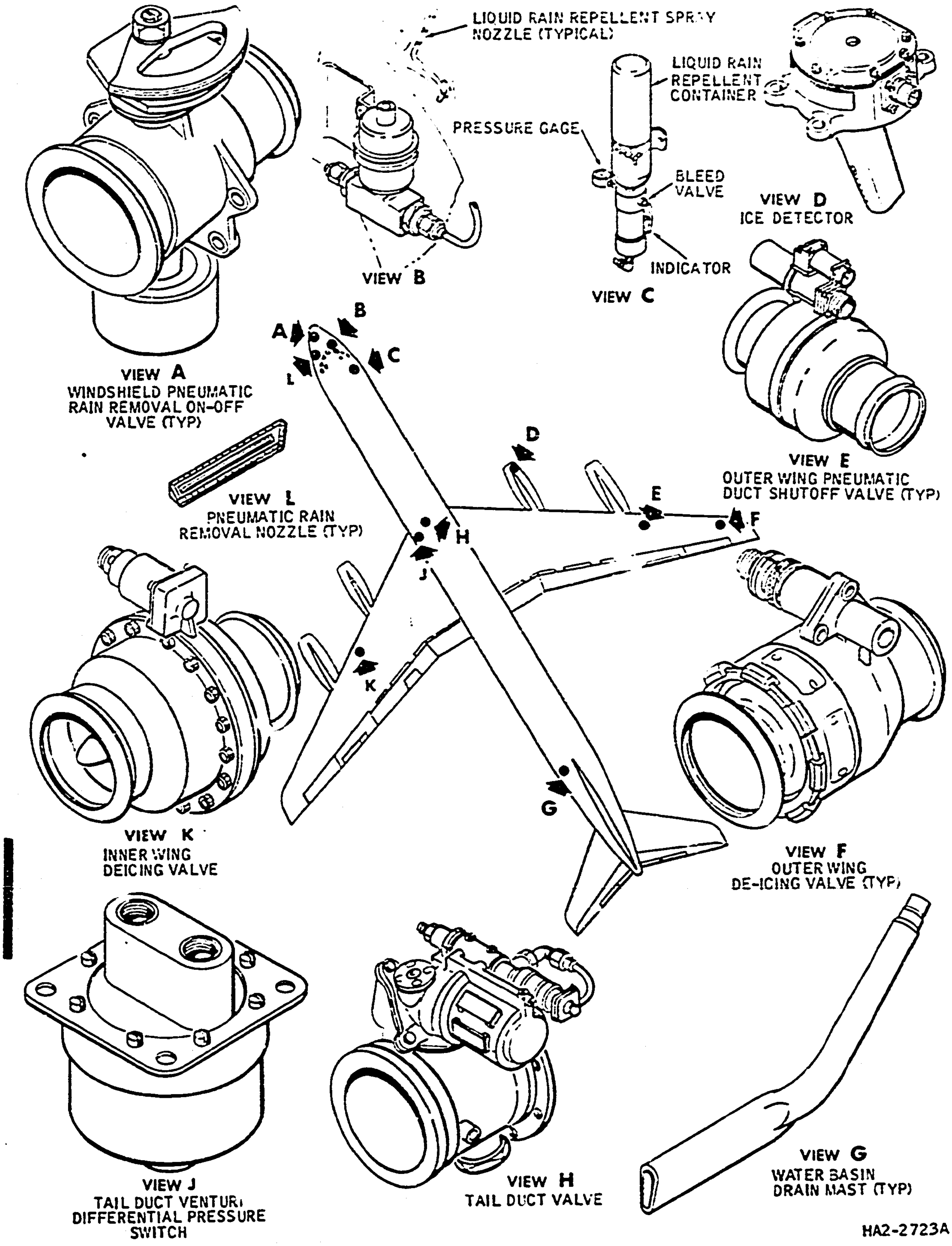
H. A liquid rain repellant system facilitates the removal of rain from the windshields. The system is controlled by momentary pushbuttons located on the flight compartment glareshield. The repellent is stored in a pressurized container located on the outside of the first officer's console.

I. An ice detection system is provided to give visual indication of the formation of ice on the surfaces of the airplane. Two ice detectors are located, one each, in the engine nacelle cowling of engine numbers 2 and 3. Two sets of indicating lights are located in the flight compartment, one set for the pilots and one for the systems engineer.



HA2-5827

Ice Protection Areas
Figure 1



Ice and Rain Protection System
Figure 2

Printed in U.S.A.

GENERAL - DESCRIPTION AND OPERATION

1. Description

A. Ice protection is provided by a deicing system to remove accumulated ice, and by anti-icing systems to prevent the formation of ice. The leading edges of the wings, including the wing leading edge slots, and the horizontal stabilizer are deiced. The fuselage nose scoops are anti-iced. For cowl and engine anti-icing, see Chapter 75. Hot air for deicing and anti-icing is supplied from the low-pressure pneumatic system. On airplanes N779FT-N7o2FT, N791FT and subsequent electrical anti-icing systems are provided for the windshields, stall warning lift transducer, pitot tubes, and water basin drain masts. On airplanes N783FT-N788FT, N790FT the windshields, stall warning lift transducer, and pitot tubes are anti-iced. Water basin drain masts are not installed.

B. The controls and indicating lights for the deicing system are grouped on the systems engineer's control panel. The pneumatic and electrical anti-icing systems are controlled and monitored from the overhead switch panel.

C. The airfoil deicing system is set in operation by placing the airfoil deicing switch in either the timer 1 or timer 2 position.

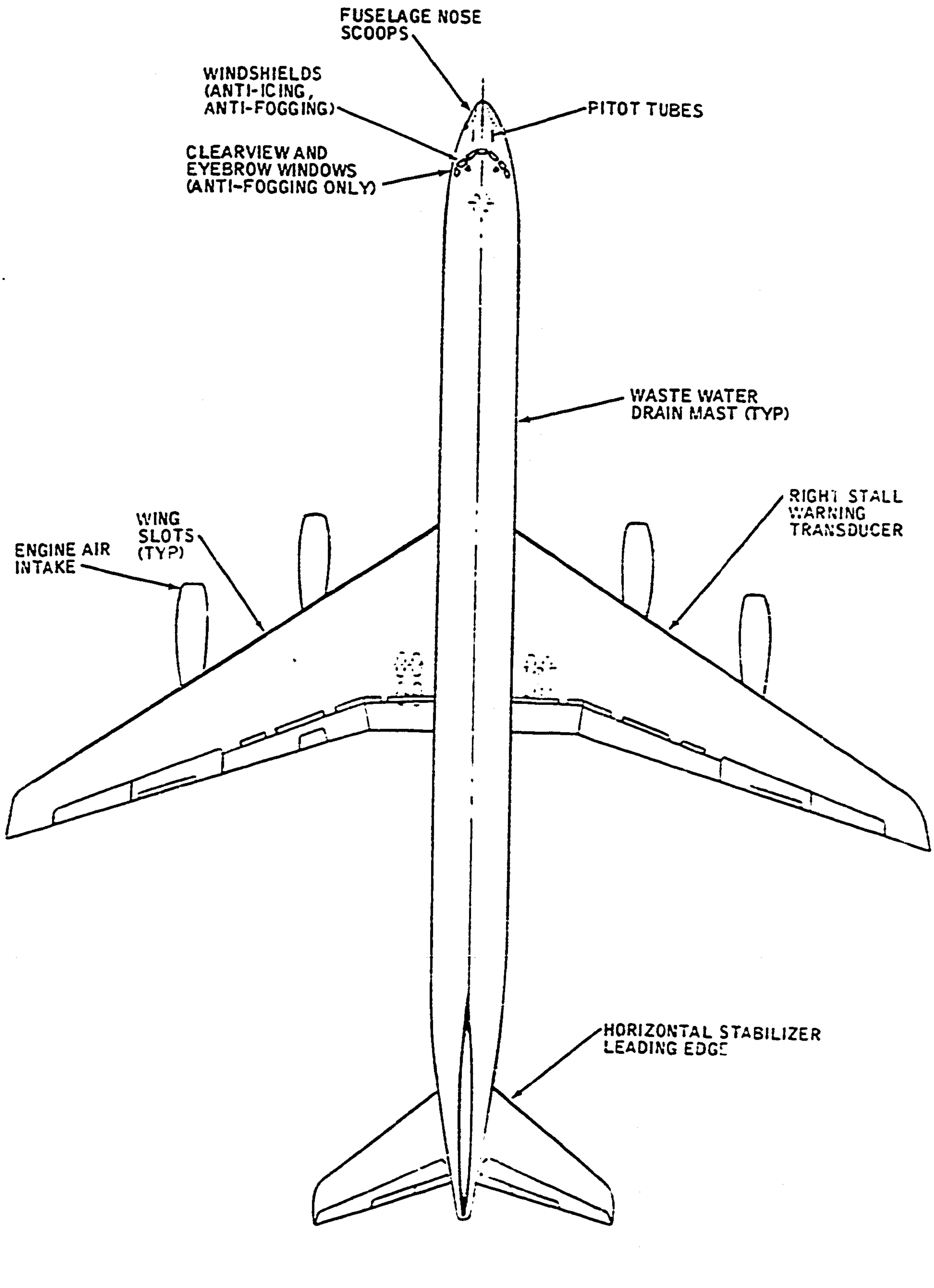
D. The scoops anti-icing system is operated from the overhead switch panel by placing the control switch in the anti-ice position.

E. The anti-icing heaters and ammeter selector switch, when placed in one of the operating positions, energizes all pitot and static port heaters and the heaters in the stall warning lift transducer.

F. The windshield and window heat control system is controlled by the windshield heat control switch located on the overhead switch panel.

G. Air from the pneumatic system is used for windshield rain removal. The flow of air is controlled by cable-actuated valves, operated by levers located in the captain's and first officer's consoles.

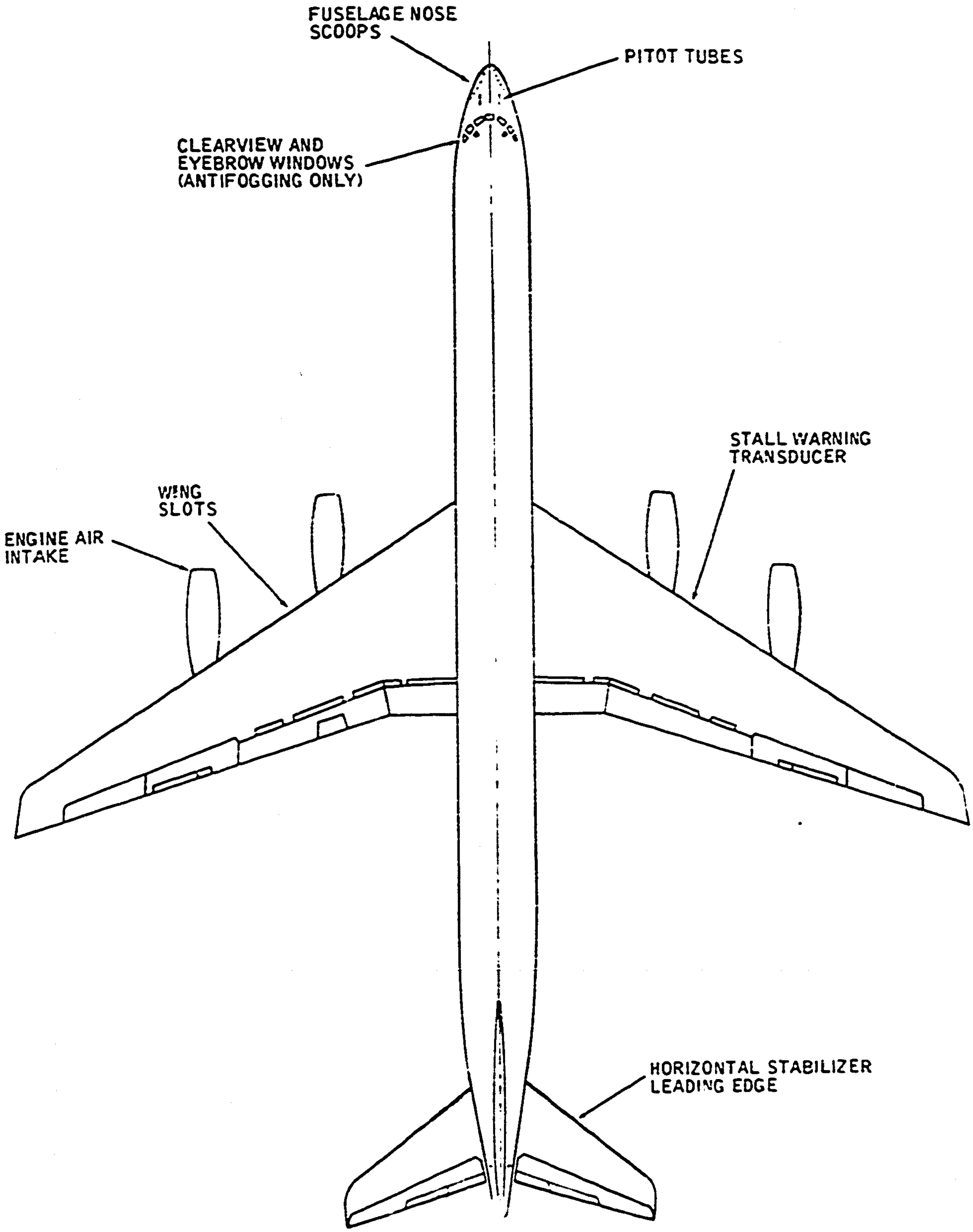
H. A liquid rain repellant system facilitates the removal of rain from the windshields. The system is controlled by momentary pushbuttons located on the flight compartment glareshield. The repellent is stored in a pressurized container located on the outside of the first officer's console.



HA2-5827

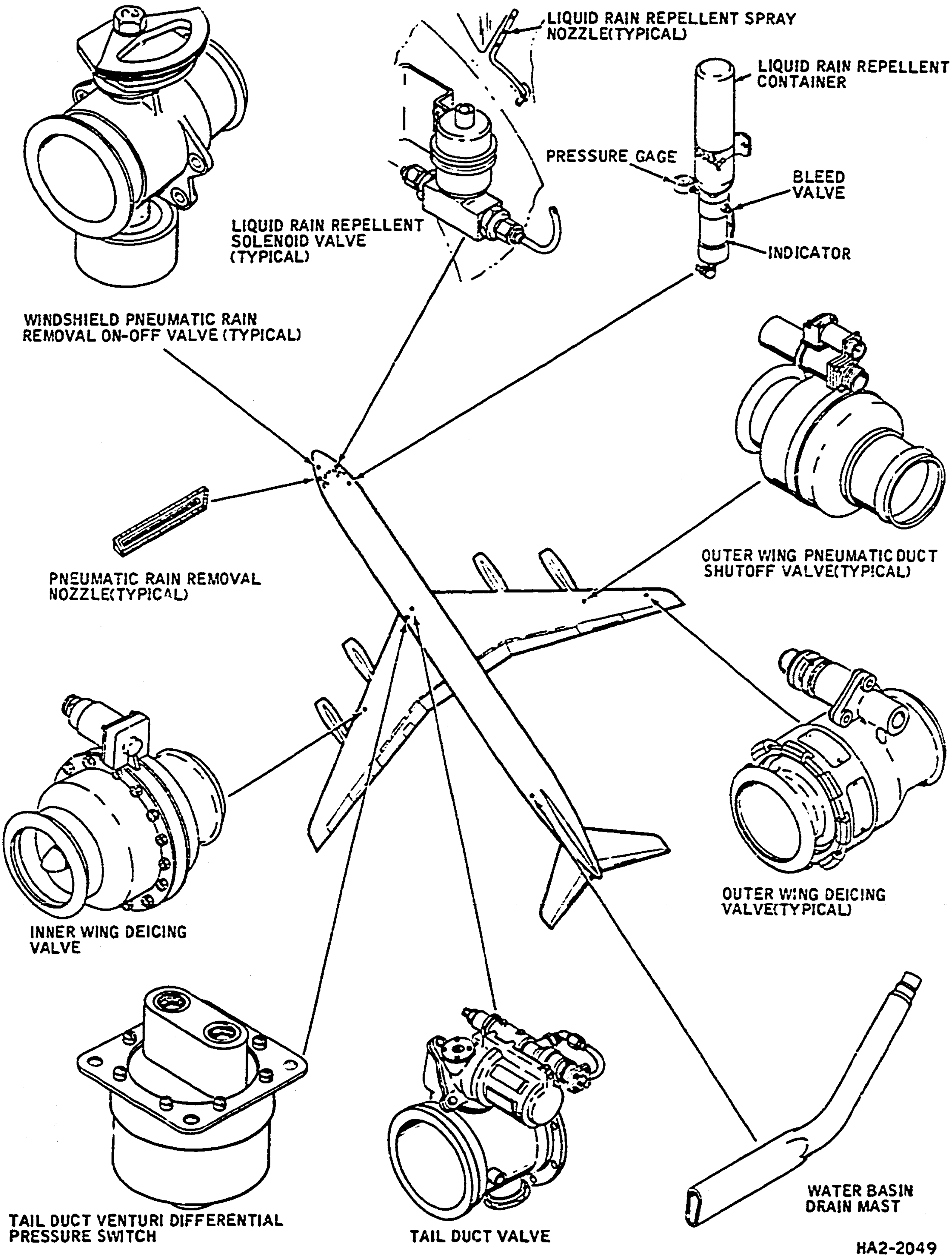
Ice Protection Areas
(Airplanes N779FT-N782FT, N791FT and Subsequent)
Figure 1 (Sheet 1)

Printed in U.S.A

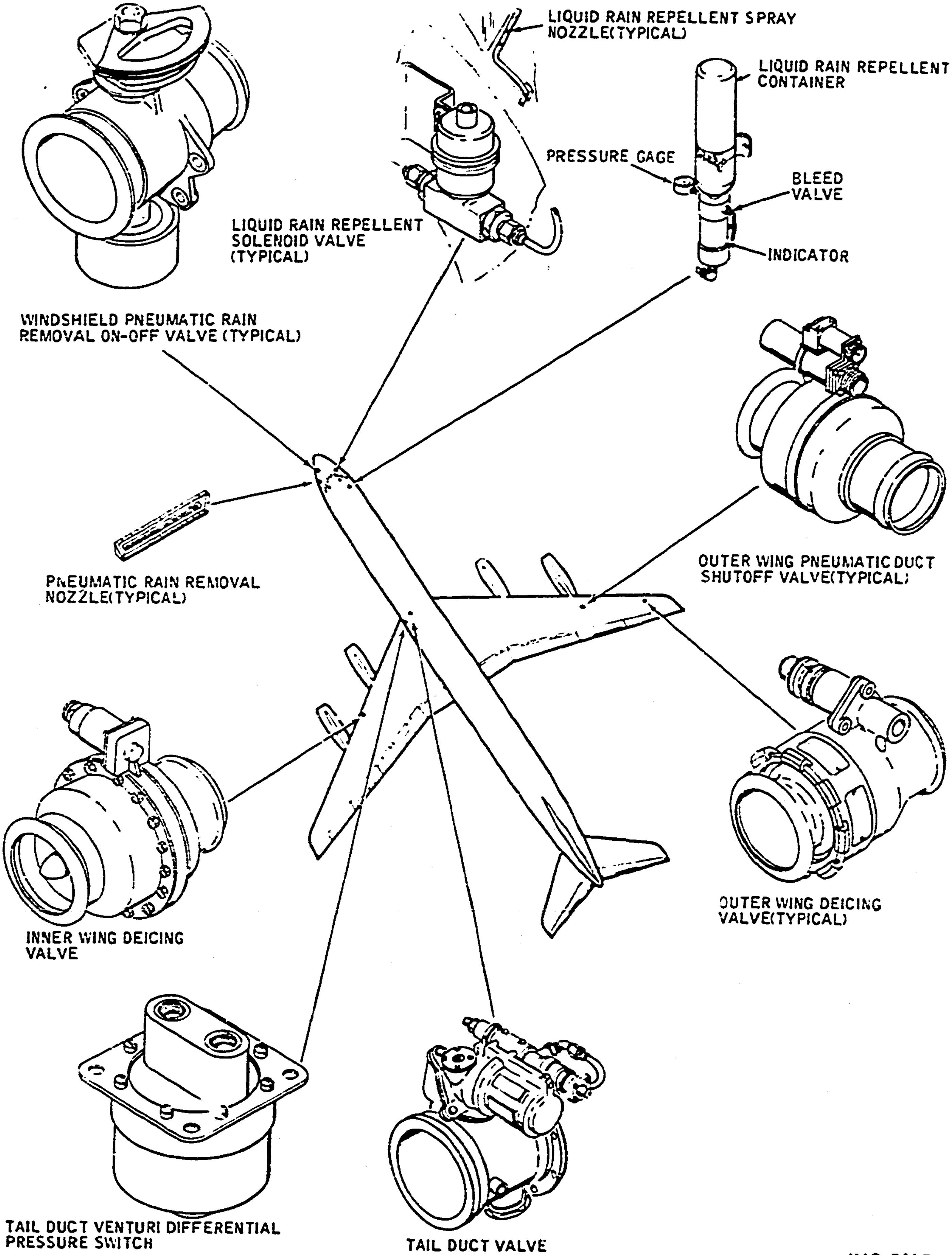


HA2-5828

Ice Protection Areas
(Airplanes N783FT-N788FT, N790FT)
Figure 1 (Sheet 2)



Ice and Rain Protection System
(Airplanes N779FT-N782FT, N791FT and Subsequent)
Figure 2 (Sheet 1)



Ice and Rain Protection System
(Airplanes N783FT-N788FT, N790FT)
Figure 2 (Sheet 2)

GENERAL - DESCRIPTION AND OPERATION

1. Description

A. Ice protection is provided by a deicing system to remove accumulated ice, and by anti-icing systems to prevent the formation of ice. The leading edges of the wings, including the wing leading edge slots, and the horizontal stabilzer are deiced. The fuselage nose scoops are anti-iced. For cowl and engine anti-icing, see Chapter 75. Hot air for deicing and anti-icing is supplied from the low-pressure pneumatic system. On Airplanes JA8031 - JA8035, JA8037 and subsequent, electrical anti-icing systems are provided for the windshields, stall warning lift transducer, pitot tubes, and water basin drain masts. Airplanes JA8038, JA8039, JA8041-JA8043, and JA8045-JA8048 have an electrical anti-icing system for the engine inlet pressure P_{t2} probes. On airplanes JA8036 and JA8044, the windshields, stall warning lift transducer, and pitot tubes are anti-iced; water basin drain masts are not installed.

B. The controls and indicating lights for the deicing system are grouped on the systems engineer's control panel. The pneumatic and electrical anti-icing systems are controlled and monitored from the overhead switch panel.

C. The airfoil deicing system is set in operation by placing the airfoil deicing switch in either the timer 1 or timer 2 position.

D. The scoops anti-icing system is operated from the overhead switch panel by placing the control switch in the anti-ice position.

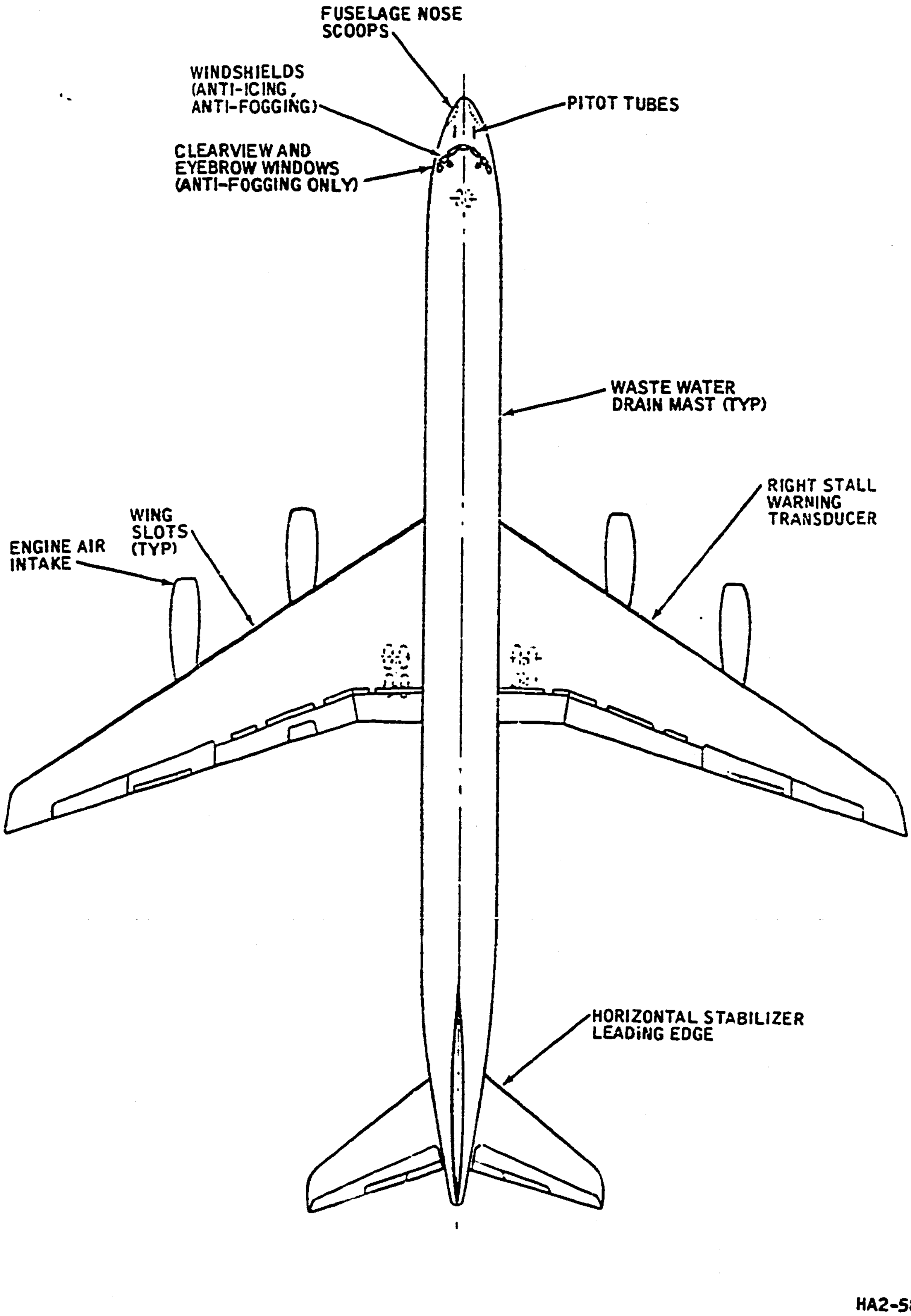
E. The anti-icing heaters and ammeter selector switch, when placed in one of the operating positions, energizes all pitot and static port heaters and the heaters in the stall warning lift transducer.

F. On airplanes JA8038, JA8039, JA8041-JA8043, and JA8045-JA8048, the engine inlet pressure (P_{t2}) probe anti-icing system controls ice accumulation around the P_{t2} probes. The system consists of a heating element in each P_{t2} probe. The probes are energized whenever the airplane electrical buses are energized.

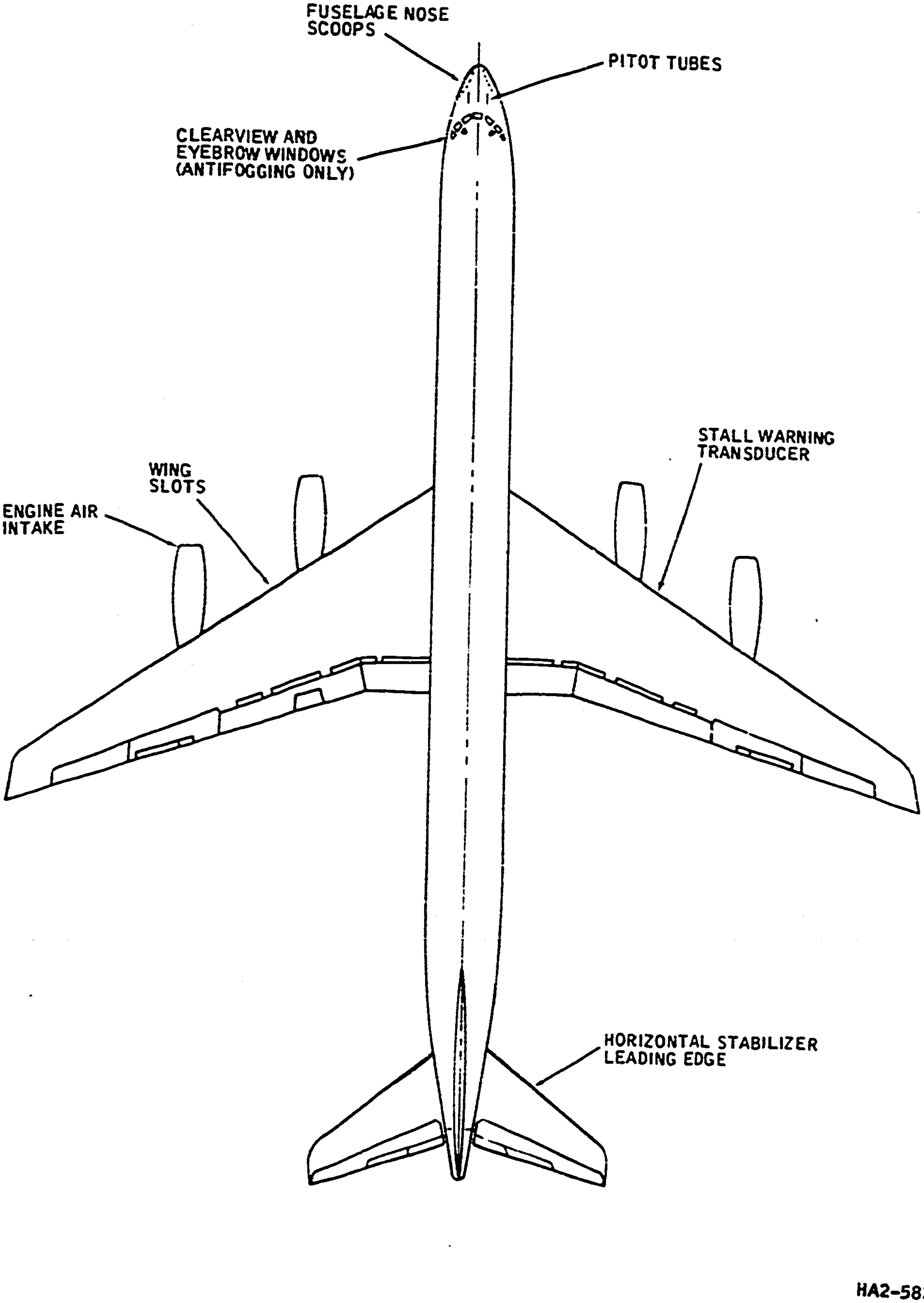
G. The windshield and window heat control system is controlled by the windshield heat control switch located on the overhead switch panel.

H. Air from the pneumatic system is used for windshield rain removal. The flow of air is controlled by cable-actuated valves, operated by levers located in the captain's and first officer's consoles.

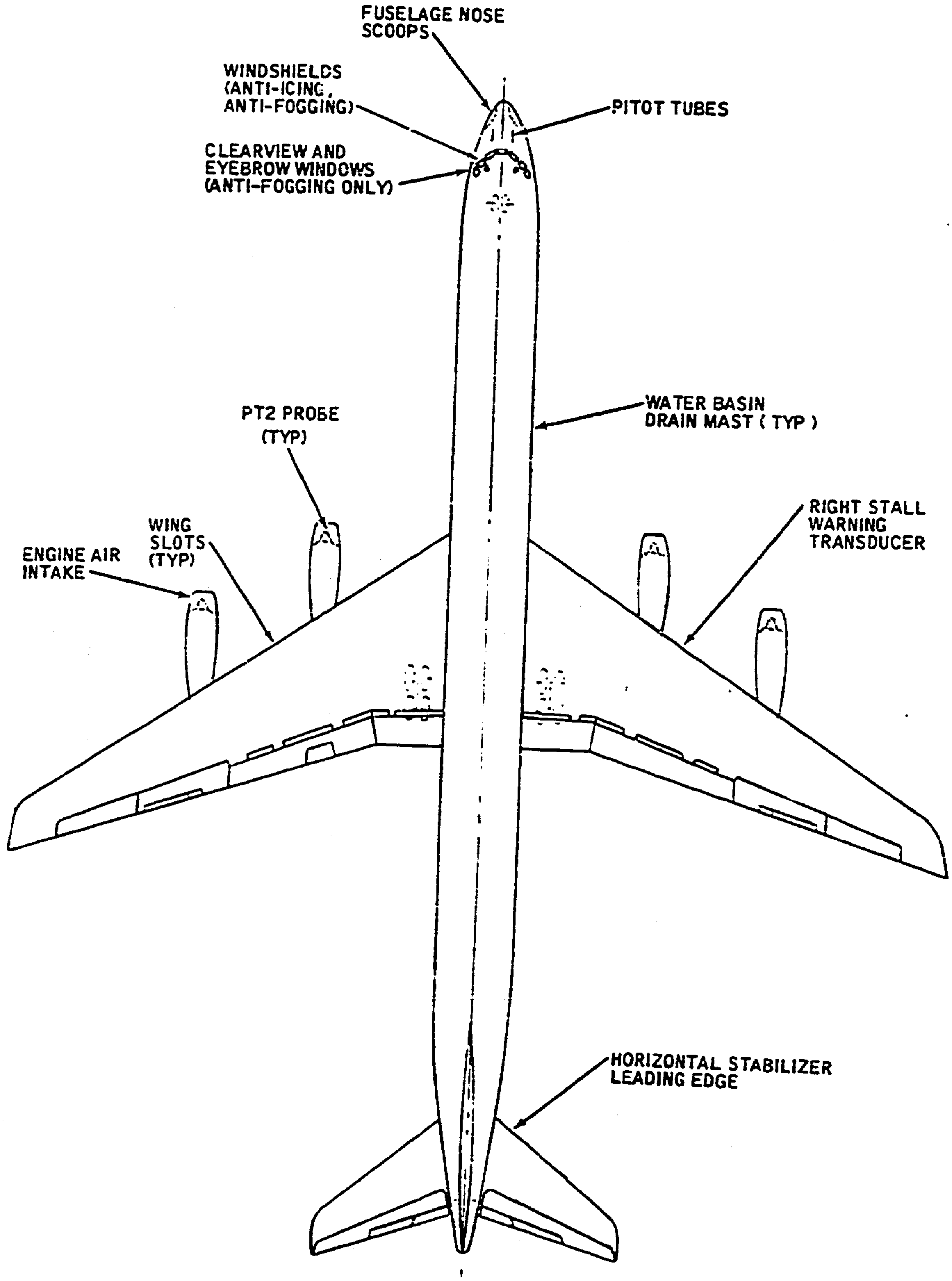
I. A liquid rain repellent system facilitates the removal of rain from the windshields. The system is controlled by momentary pushbuttons located on the flight compartment glareshield. The repellant is stored in a pressurized container located on the outside of the first officer's console.



Ice Protection Areas
(Airplanes JA8031-JA8035, JA8037, JA8040,
JA8051 and Subsequent)
Figure 1 (Sheet 1)

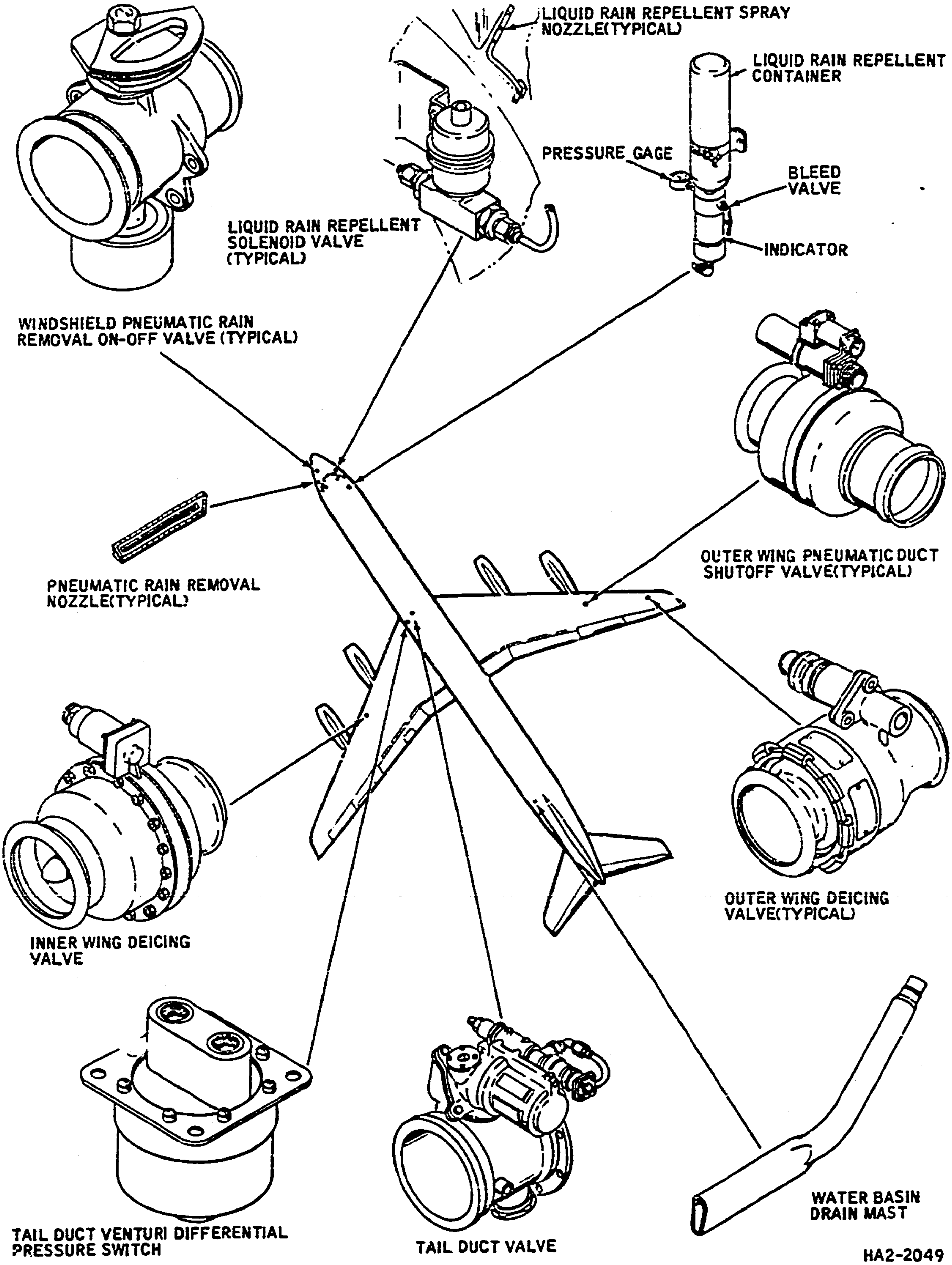


Ice Protection Areas
(Airplanes JA8036 and JA8044)
Figure 1 (Sheet 2)

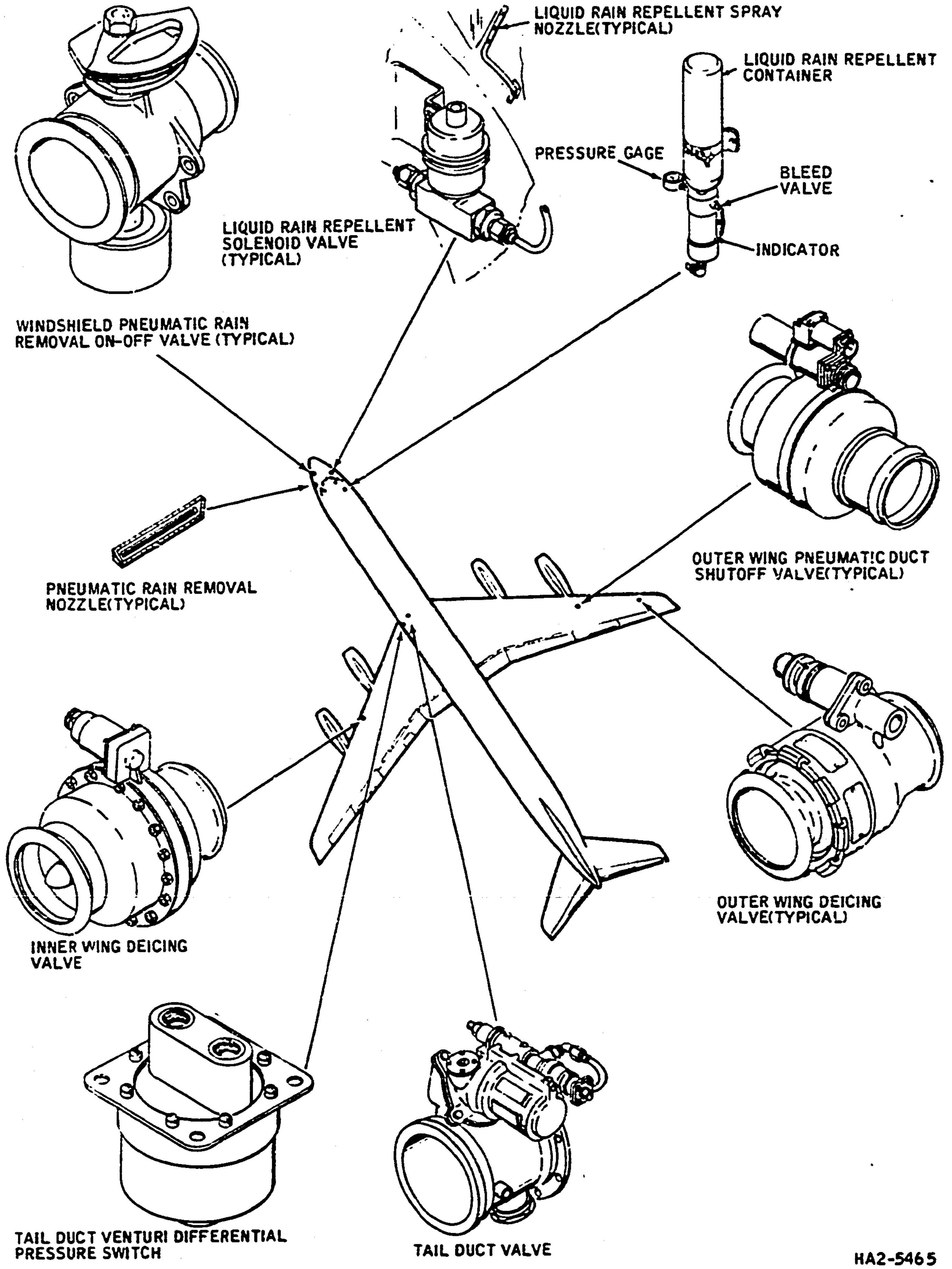


HA2-1544

Ice Protection Areas
(Airplanes JA8038, JA8039, JA8041-JA8043, and JA8045-JA8048)
Figure 1 (Sheet 3)



Ice and Rain Protection System
(Airplanes JA8031-JA8035, JA8037-JA8043,
JA8045 and Subsequent)
Figure 2 (Sheet 1)



Ice and Rain Protection System
(Airplanes JA8036 and JA8044)
Figure 2 (Sheet 2)

GENERAL - DESCRIPTION AND OPERATION

1. Description

A. Ice protection is provided by a deicing system to remove accumulated ice, and by anti-icing systems to prevent the formation of ice. The leading edges of the wings, including the wing leading edge slots, and the horizontal stabilizer are deiced, The fuselage nose scoops are anti-iced. For cowl and engine anti-icing, see Chapter 75. Hot air for deicing and anti-icing is supplied from the low-pressure pneumatic system. Electrical anti-icing systems are provided for the windshields, stall warning lift transducer, pitot tubes, and water basin drain masts.

B. The controls and indicating lights for the deicing system are grouped on the systems engineer's control panel. The pneumatic and electrical anti-icing systems are controlled and monitored from the overhead switch panel.

C. The airfoil deicing system is set in operation by placing the airfoil deicing switch in either the timer 1 or timer 2 position.

D. The scoops anti-icing system is operated from the overhead switch panel by placing the control switch in the anti-ice position.

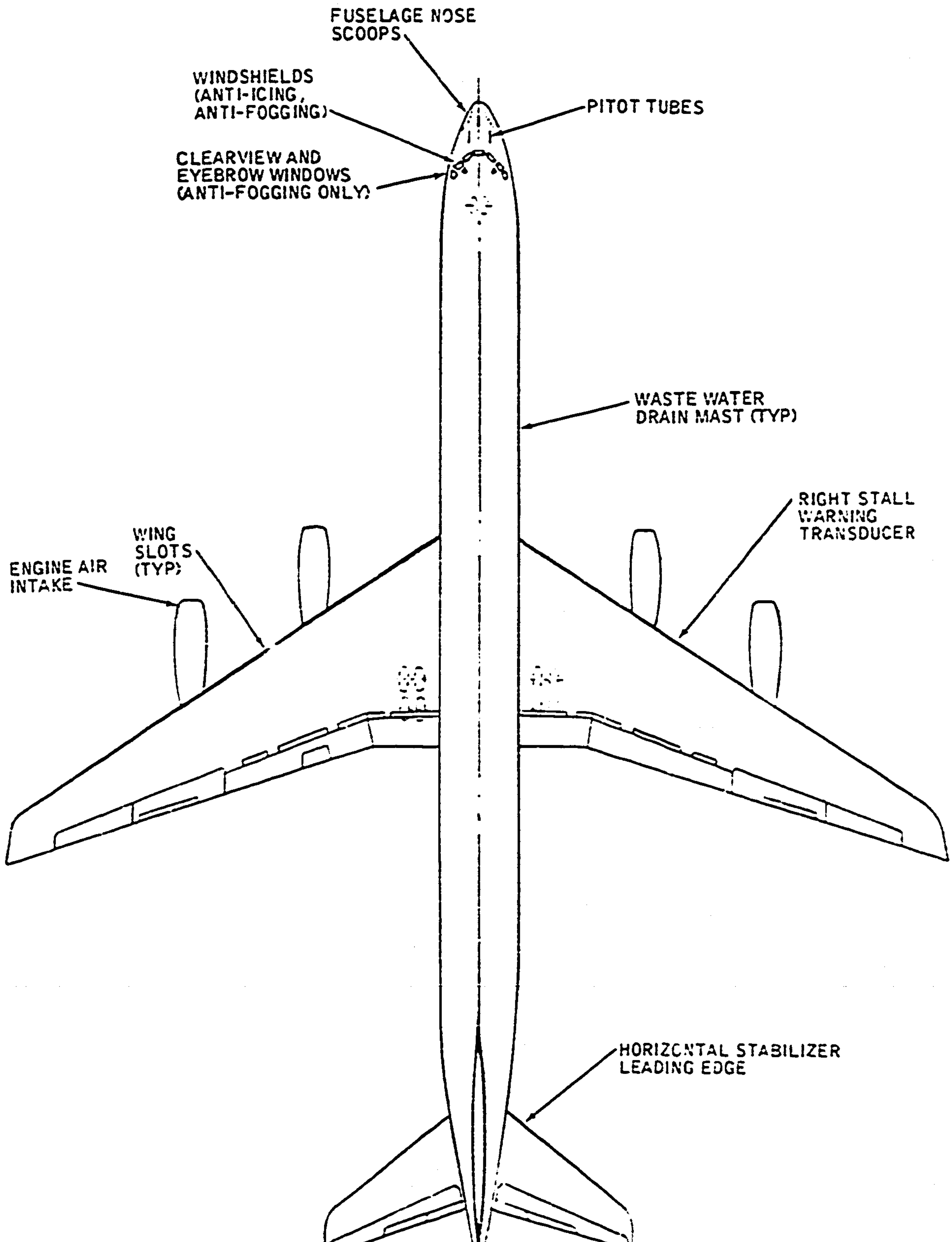
E. The anti-icing heaters and ammeter selector switch, when placed in one of the operating positions, energizes all pitot and static port heaters and the heaters in the stall warning lift transducer.

F. The windshield and window heat control system is controlled by the windshield heat control switch located on the overhead switch panel.

G. Air from the pneumatic system is used for windshield rain removal. The flow of air is controlled by cable-actuated valves, operated by levers located in the captain's and first officer's consoles.

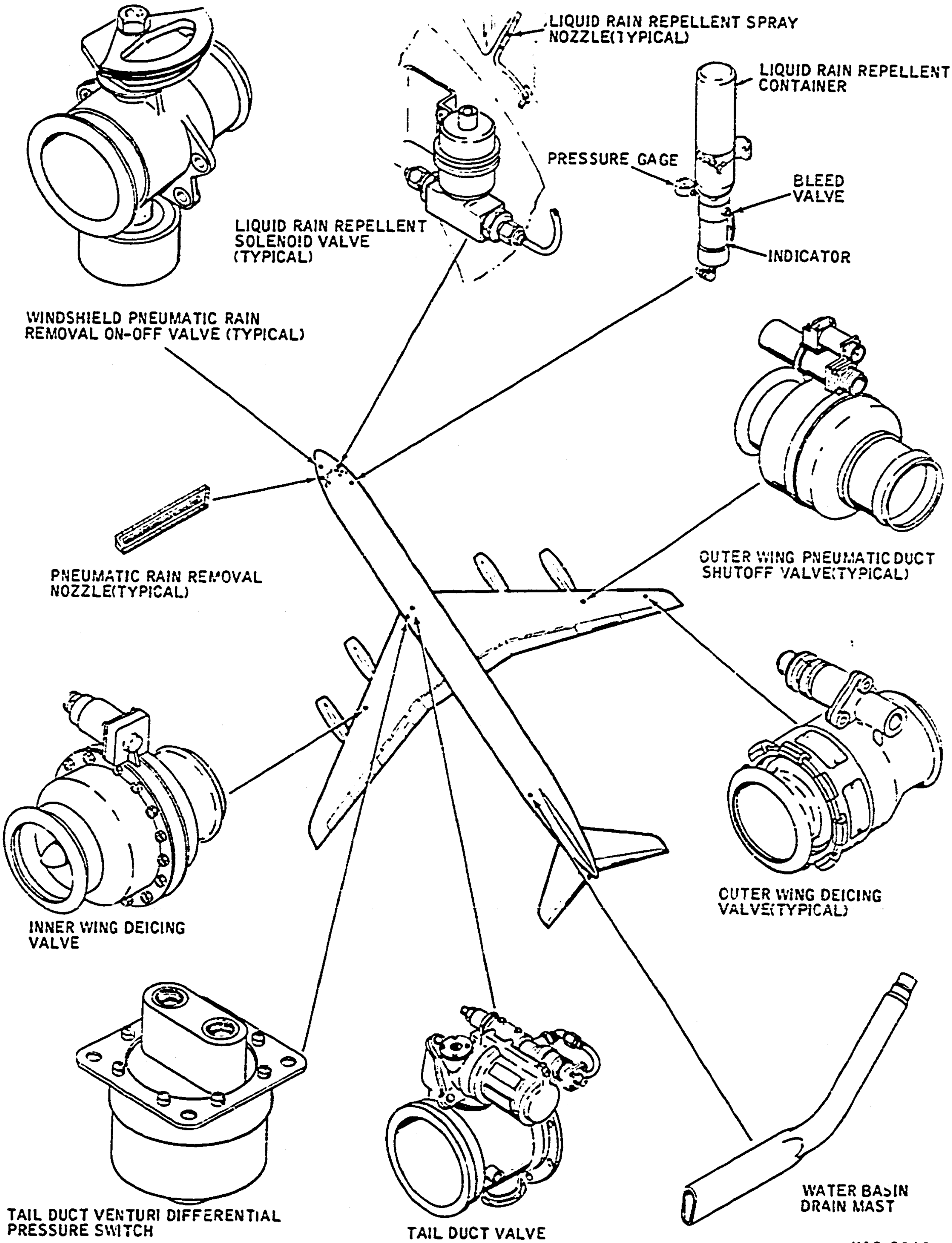
H. A liquid rain repellant system facilitates the removal of rain from the windshields. The system is controlled by momentary pushbuttons located on the flight compartment glareshield. The repellant is stored in a pressurized container located on the outside of the first officer's console.

Printed in U.S.A.



Ice Protection Areas
Figure 1

Printed in U.S.A.



Ice and Rain Protection System
Figure 2

GENERAL - MAINTENANCE PRACTICES

1. General

A. O-rings should be discarded when removed, and replaced with new O-rings. The specific O-rings used in the ice and rain protection systems are shown in Figure 201.

B. The maintenance practices for the various ice protection system relays are similar, varying only as to location and access.

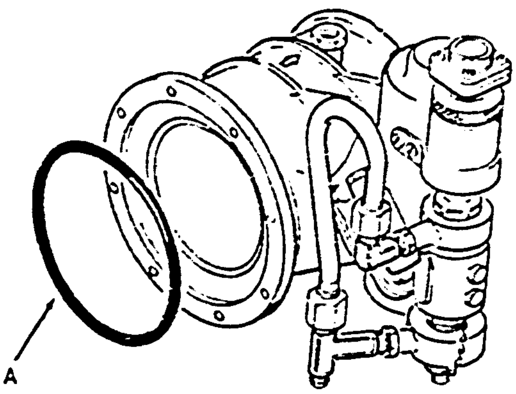
CAUTION: CAP ALL OPEN DUCTS AND FITTINGS TO PREVENT FOREIGN OBJECTS, DIRT, OIL, OR GREASE FROM ENTERING SYSTEM. CAP BOTH MATING SURFACES OF ALL ELECTRICAL CONNECTORS. KEEP ALL CAPS IN CLEAN CONTAINERS WHEN NOT IN USE.

WARNING: TAG AND SAFETY ALL CIRCUIT BREAKERS (SEE CHAPTER 20).

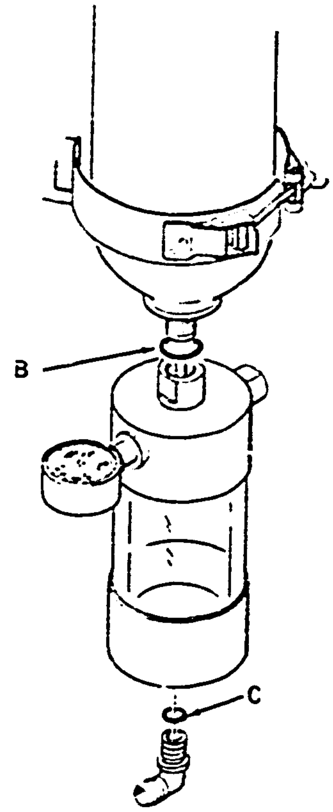
2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

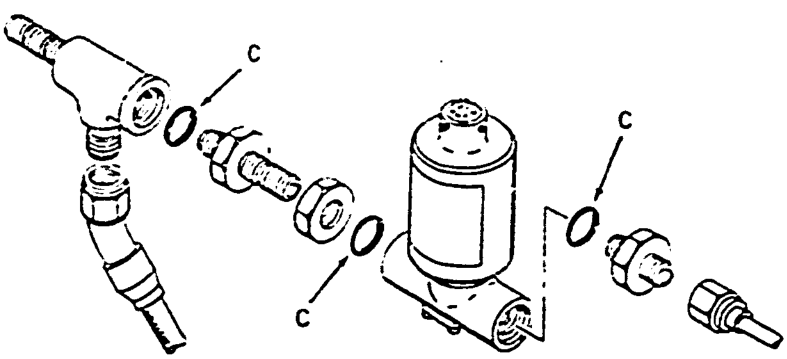
Item	Name	Number	Manufacturer	Use
A	Primer	A-4094	Dow Corning Co.	Surface priming
B	Fthyl Acetate		Commercially available	Clean surface
C	Douglas Stripper	No. 14	Commercially available	Clean surface
D	Catalyst with RTV-992	RTV-1016	General Electric, Silicone Products Dept.	Seal ducts
E	Catalyst with RTV-992	RTV-90		Seal ducts



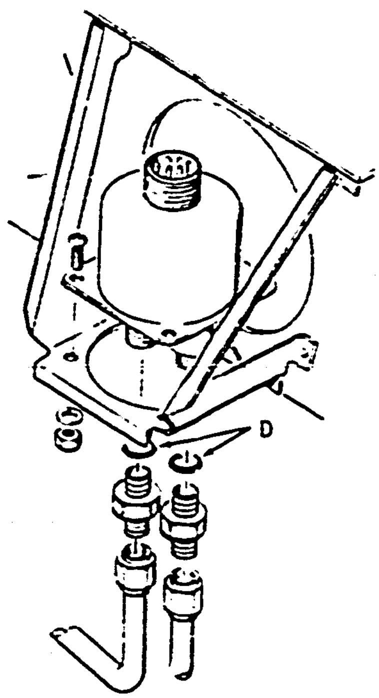
TAIL DUCT VALVE



WINDSHIELD LIQUID RAIN REPELLENT
QUANTITY INDICATOR



WINDSHIELD LIQUID RAIN REPELLENT
SOLENOID VALVE (TYPICAL)



TAIL DUCT DIFFERENTIAL
PRESSURF SWITCH

CODE:

A 6806 (JOHNS MANSFIELD)
B 66-20263-1 (BOEING COMPANY)
C AN6227-7
D 250-630-4 (PARKER SEAL COMPANY)

HA2-4190

Ice and Rain Protection O-ring Installation
Figure 201

3. Thermal Deicing Sealing

A. General Maintenance Instructions

(1) Clean all surfaces with Douglas No. 14 stripper. Ethyl acetate is a permissible substitute for Douglas No. 14 stripper.

(2) Prime all sufaces with A-4094 primer. Allow primer to dry for a minimum of 60 minutes before applying sealant. Keep primer container tightly closed when not in use. Use primer from small containers to prevent contamination of primer. Discard primer when it turns milky.

(3) When patching or tying into cured sealant with uncured material, thoroughly wipe tie-in area with A-4094 primer. This is necessary to obtain proper adhesion of cured to uncured sealant.

B. Sealing Instructions

(1) Use RTV-1016 (or RTV-90) to seal deicing ducts of wing leading edge as follows:

(a) Apply sealant in faying surfaces of all members, approximately 1 inch wide around cutouts through D-duct or outer plating.

(b) Apply sealant on faying surfaces, approximately 1 inch wide around door cutouts, between inner plating and outer plating.

(c) Apply sealant between lap splices of inner platings at all inner plating splices.

(d) Apply sealant between inner plating and outer plating in area of attachment wherever inner plating ends. (The first row of attachments aft of exhaust holes are for aft edges.)

(e) Apply faying surface seal between all members at both ends of D-ducts in area of D-duct only.

(f) Apply fillet seal to seams at D-duct attaching angles and around doubler where D-duct platings are spliced.

(g) Install D-duct blocks with full faying surface seal. Apply sufficient amount of sealant in joggles to ensure squeeze-out of sealant after attachments are installed.

(h) Apply faying surface seal between outer plating and splice doubler in all areas where outer platings are spliced.

4. Removal/Installation Ice Protection System Relays

A. Remove Relay

(1) Remove electrical power from relay by either step (a) or (b).

(a) Open applicable circuit breaker(s).

1) Install clamp under open circuit breaker(s). Suitable clamp is HPV-5N (Burndy) or P4-5WS (Nylon Molding Corporation).

2) Tag circuit breaker(s) with warning sign.

WARNING: DO NOT CLOSE THIS CIRCUIT BREAKER. THIS CIRCUIT BREAKER MUST REMAIN OPEN UNTIL COMPLETION OF MAINTENANCE WORK.

(b) Disconnect external power. Tag external power receptacle with warning sign.

WARNING: DO NOT APPLY EXTERNAL POWER.

(2) Gain access to relay.

(3) Tag and disconnect wires.

(4) Support relay and remove mounting screws.

(5) Remove relay.

B. Install Relay

(1) Make certain that power is removed. as callout in paragraph 4, step A (1).

(2) Position relay.

NOTE: Before installation, make certain that paint is removed from relay mounting flange so that a good electrical bond between relay and structure of airplane is provided.

(3) Install and tighten mounting screws.

(4) Connect wires, making certain that leads are connected correctly.

(5) Remove tags from wires.

(6) Replace parts removed to gain access to relay.

(7) Remove warning tag. Apply external power or close circuit breaker (s), as applicable.

(8) Follow applicable system adjustment/test procedures to determine that relay is functioning properly.

GENERAL - MAINTENANCE PRACTICES

1. General

A. O-rings should be discarded when removed, and replaced with new O-rings. The specific O-rings used in the ice and rain protection systems are shown in Figure 201.

B. The maintenance practices for the various ice protection system relays are similar, varying only as to location and access.

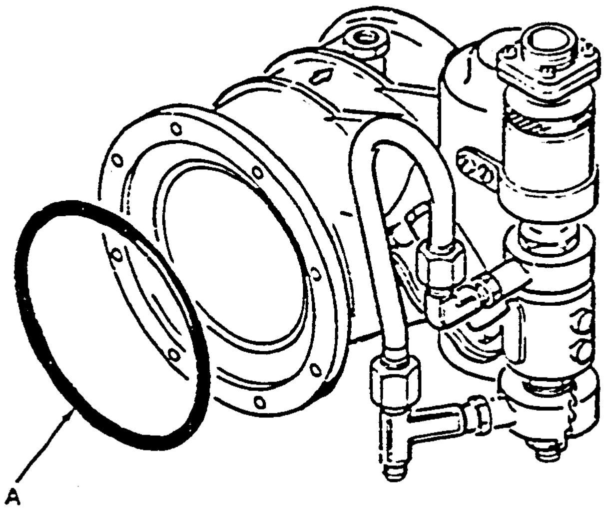
CAUTION: CAP ALL OPEN DUCTS AND FITTINGS TO PREVENT FOREIGN OBJECTS, DIRT, OIL, OR GREASE FROM ENTERING SYSTEM. CAP BOTH MATING SURFACES OF ALL ELECTRICAL CONNECTORS. KEEP ALL CAPS IN CLEAN CONTAINERS WHEN NOT IN USE.

WARNING: TAG AND SAFETY ALL CIRCUIT BREAKERS (SEE CHAPTER 20).

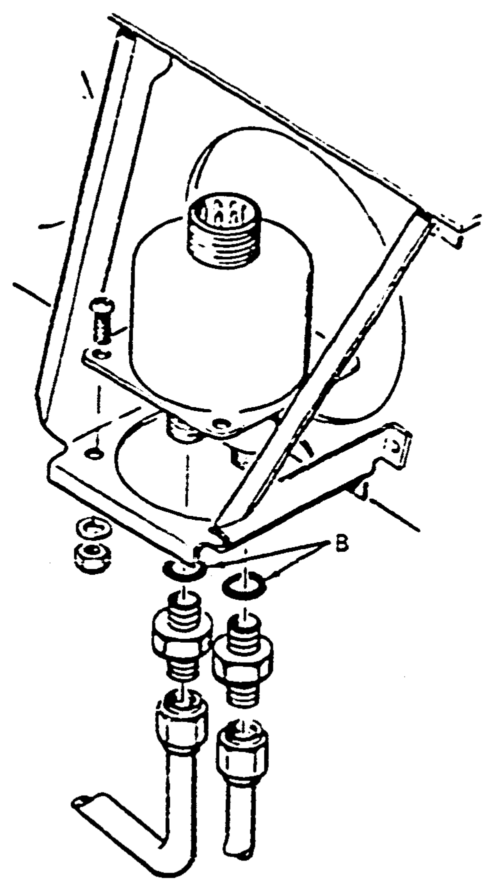
2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Primer	A-4094	Dow Corning Co.	Surface priming
B	Ethyl Acetate		Commercially available	Clean surface
C	Douglas Stripper	No. 14	Commercially available	Clean surface
D	Catalyst with RTV-992	RTV-1016	General Electric, Silicone Products Dept.	Seal ducts
E	Catalyst with RTV-992	RTV-90		Seal ducts



TAIL DUCT VALVE



CODE:
A 6806 (JOHNS MANSFIELD)
B 250-630-4 (PARKER SEAL COMPANY)

TAIL DUCT DIFFERENTIAL
PRESSURE SWITCH

HA2-4953

Ice and Rain Protection O-ring Installation
Figure 201

3. Thermal Deicing Sealing

A. General Maintenance Instructions

(1) Clean all surfaces with Douglas No. 14 stripper. Ethyl acetate is a permissible substitute for Douglas No. 14 stripper.

(2) Prime all surfaces with A-4094 primer. Allow primer to dry for a minimum of 60 minutes before applying sealant. Keep primer container tightly closed when not in use. Use primer from small containers to prevent contamination of primer. Discard primer when it turns milky.

(3) When patching or typing into cured sealant with uncured material, thoroughly wipe tie-in area with A-4094 primer. This is necessary to obtain proper adhesion of cured to uncured sealant.

B. Sealing Instructions

(1) Use RTV-1016 (or RTV-90) to seal deicing ducts of wing leading edge as follows:

(a) Apply sealant in faying surfaces of all members, approximately 1 inch wide around cutouts through D-duct or outer plating.

(b) Apply sealant on faying surfaces, approximately 1 inch wide around door cutouts, between inner plating and outer plating.

(c) Apply sealant between lap splices of inner platings at all inner plating splices.

(d) Apply sealant between inner plating and outer plating in area of attachment wherever inner plating ends. (The first row of attachments aft of exhaust holes are for aft edges.)

(e) Apply faying surface seal between all members at both ends of D-ducts in area of D-duct only.

(f) Apply fillet seal to seams at D-duct attaching angles and around doubler where D-duct platings are spliced.

(g) Install D-duct blocks with full faying surface seal. Apply sufficient amount of sealant in joggles to ensure squeeze-out of sealant after attachments are installed.

(h) Apply faying surface seal between outer plating and splice doubler in all areas where outer platings are spliced.

4. Removal/Installation Ice Protection System Relays

A. Remove Relay

(1) Remove electrical power from relay by either step (a) or (b).

(a) Open applicable circuit breaker(s).

1) Install clamp under open circuit breaker(s). Suitable clamp is HPV-5N (Burndy) or P4-5WS (Nylon Molding Corporation).

2) Tag circuit breaker(s) with warning sign.

WARNING: DO NOT CLOSE THIS CIRCUIT BREAKER. THIS CIRCUIT BREAKER MUST REMAIN OPEN UNTIL COMPLETION OF MAINTENANCE WORK.

(b) Disconnect external power. Tag external power receptacle with warning sign.

WARNING: DO NOT APPLY EXTERNAL POWER.

(2) Gain access to relay.

(3) Tag and disconnect wires.

(4) Support relay and remove mounting screws.

(5) Remove relay.

B. Install Relay

(1) Make certain that power is removed, as called out in paragraph 4, step A (1).

(2) Position relay.

NOTE: Before installation, make certain that paint is removed from relay mounting flange so that a good electrical bond between relay and structure of airplane is provided.

(3) Install and tighten mounting screws.

(4) Connect wires, making certain that leads are connected correctly.

(5) Remove tags from wires.

(6) Replace parts removed to gain access to relay.

(7) Remove warning tag. Apply external power or close circuit breaker(s), as applicable.

(8) Follow applicable system adjustment/test procedures to determine that relay is functioning properly.

AIRFOIL - DESCRIPTION AND OPERATION

1. General

A. The airfoil deicing system removes ice from the leading edges of the wing, the leading edges of the wing slots, the wing slots lower doors, and the leading edges of the horizontal stabilizer. Hot air from the low-pressure pneumatic system is distributed to the leading edges through a system of ducts and by electrically controlled, pneumatically operated valves.

B. Eighteen deicing valves, 16 of which are operated in pairs by either one or two timers, permit intermittent airflow to the deicing segments.

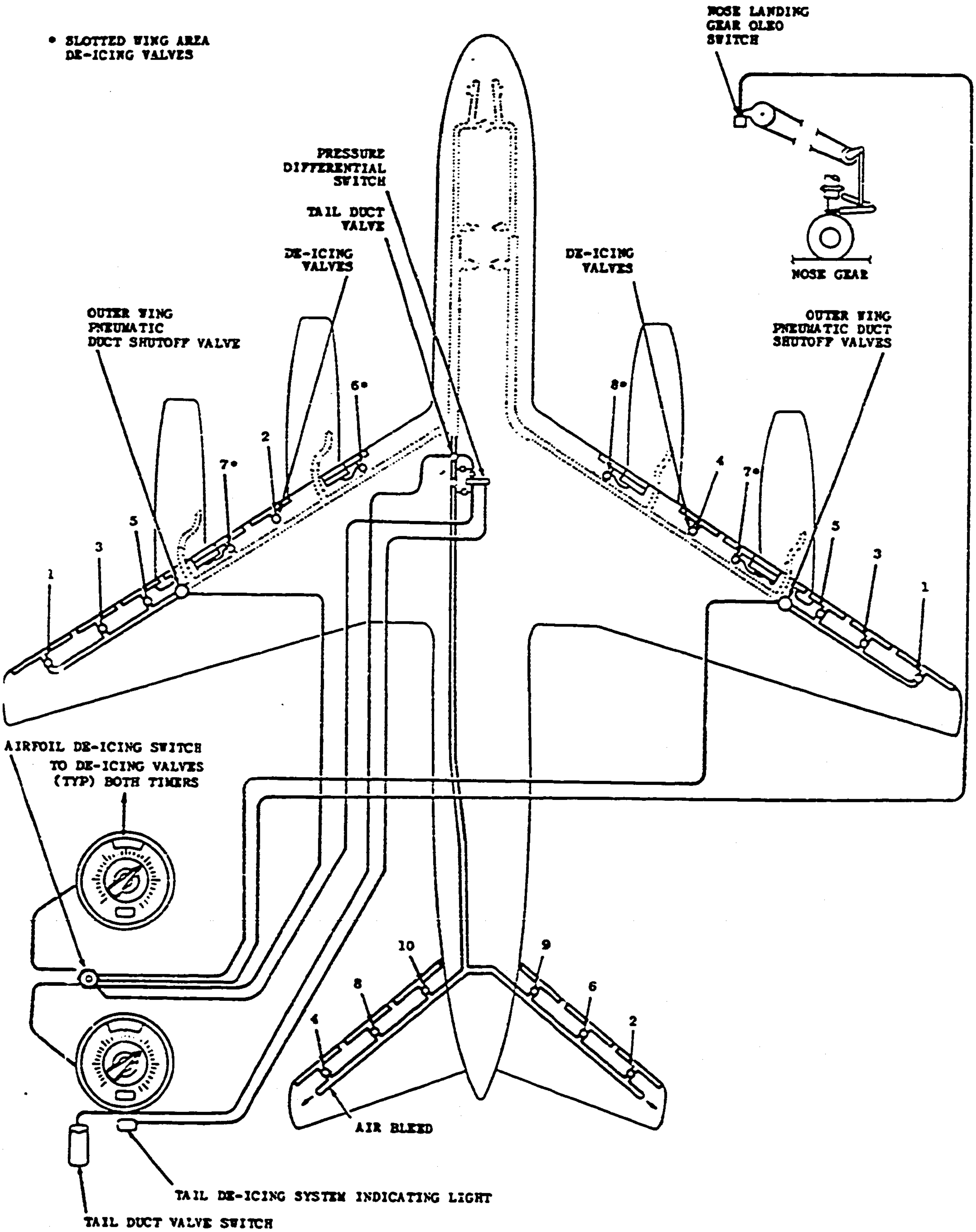
C. An interlock wing slot deice relay is actuated when the landing gear control lever is placed in the down position. This permits a triple-cycle feature to deice the slotted wing sections approximately three times as often as the wing sections without slots.

C. Controls for the system are located on the system engineer's control panel. They include the airfoil deicing switch, two identical timers, a guarded tail duct valve switch, and a tail deicing system indicating light. The system is electrically interlocked with the ground control relay circuit so that the deicing valves cannot be operated on the ground.

E. The deicing timer motors, the tail duct valve, and the outer wing pneumatic duct shutoff valves are independent of the ground control relay.

F. Air directed to the center and inner wing leading edges (inboard of No. 1 and 4 pylons) is supplied directly by the pneumatic manifold. From the low-pressure penumatic manifold, air is directed to the left and right outer wings (outboard of No. 1 and 4 pylons) through the outer wing pneumatic duct shutoff valves, and to the empennage through the tail duct valve and the tail duct. The tail duct extends from the tail duct valve in the fuselage to the tail section of the airplane. This duct is located on the left side of the fuselage below the floor, in the pressurized area, and extends into the horizontal stabilizer. D-ducts in the leading edge of each airfoil are divided into a total of 18 sections and direct the distribution of air through the leading edge areas to be deiced. All D-ducts are riveted to ribs located in the wing and stabilizer leading edges, and are removed and installed as integral components of the leading edge structure (see Chapters 55 and 57). The deicing air exhausts overboard from the wing leading edges through slots in the lower surface between pylons. Air from the horizontal stabilizer leading edges exhausts into the tail cone and overboard through slots in the tail cone, the elevator torque tube, and the horizontal stabilizer torque box.

G. V-band clamps and flexible connectors connect the tail duct sections. The flexible connectors in the pressurized area are a double-walled type, similar to the connectors used in the pneumatic manifold (see Chapter 36) with the exception of the attaching flanges. The connectors in the



Airfoil Deicing System -- Schematic
Figure 1

nonpressurized area (tail section) are a single-walled type attached to the beaded ends of the duct with clamps.

H. The tail duct directs air to the horizontal stabilizer. A Y-duct in the horizontal stabilizer with a flexible connector located at the pivot of the stabilizer allows the duct to flex with stabilizer movement. The ducts in the stabilizer leading edge have three deicing ports on each side of the stabilizer. Deicing valves are connected to these ports and to the D-duct sections in the leading edge. A bleed orifice is located near the outboard end of the ducts. Air from the tail duct bleeds into the leading edge area from these orifices, ensuring a hot air supply to all tail deicing valves when the tail duct valve is open.

I. A flow-limiting venturi, located just downstream of the tail duct valve, provides a pressure signal for the tail duct valve differential-pressure switch. Two sensing lines are connected across the venturi, one at the throat and one immediately upstream of the venturi.

J. The outer wing ducts extend from the outer wing pneumatic duct shutoff valves, connected to the penumatic manifold (outboard of No. 1 and 4 pylons), to the wing tips. An anti-icing air outlet is located near the outboard end of each duct. The two ducts are composed of sections connected with clamps and single-wall flexible connectors. Each section is supported by a fixed and slip-type bracket. The fixed bracket holds the duct section rigid where the deicing valves attach to the deicing air outlets. The slip supports allow the duct to expand and contract, and also allow for structural deflections.

K. The airfoil deicing controls and indicating light system provides for electrical control and monitoring of the deicing of the wing and tail surfaces. The system controls and indicating light are located on the systems engineer's control panel and include the following:

(1) Airfoil deicing switch, with timer 1--off--timer 2 positions

(2) Two airfoil timers (these also act as cycle sequence indicators).

(4) Tail deicing system indicating light

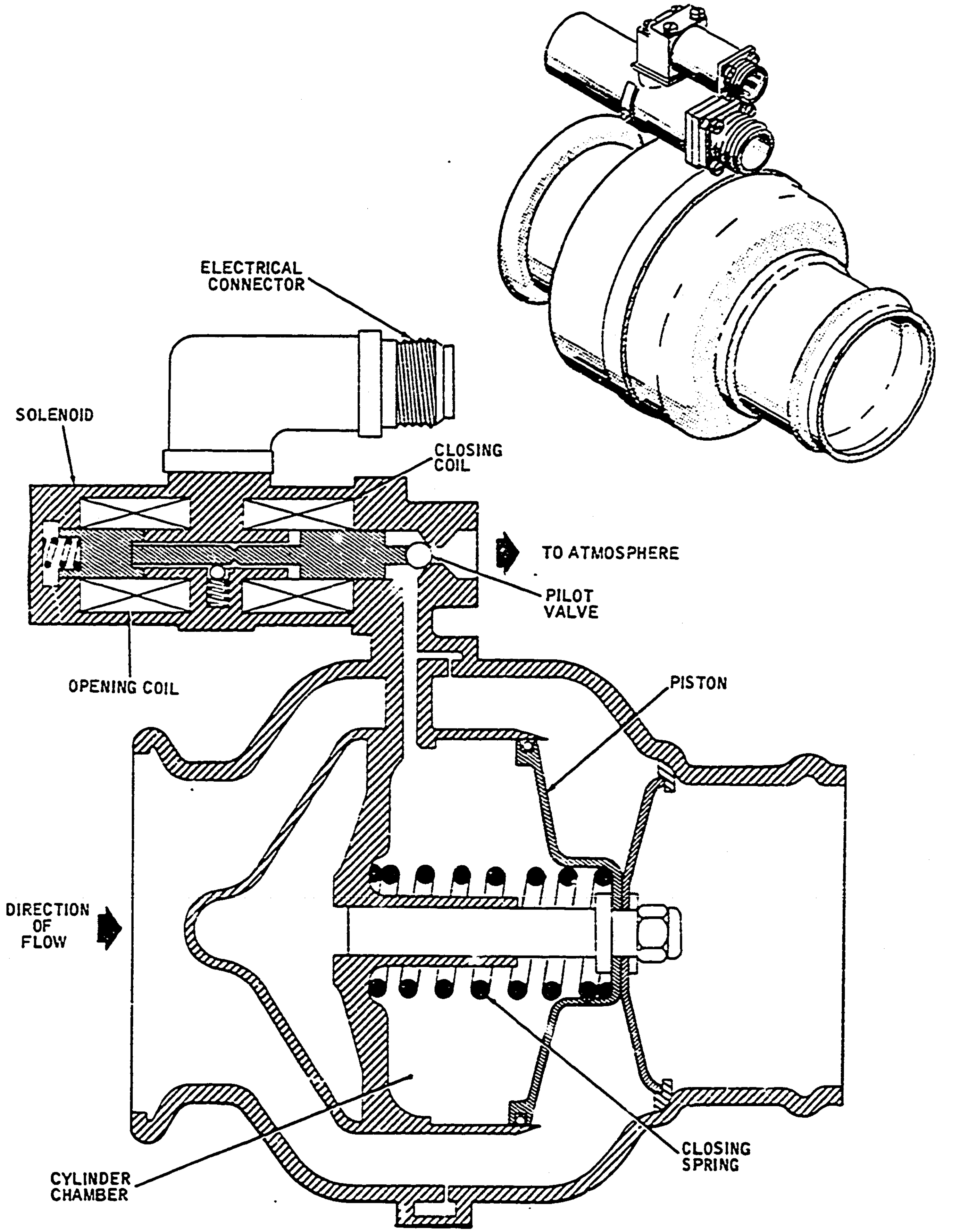
(5) Tail duct valve switch, with normal--off positions.

2. Component Description

A. Outer Wing Pneumatic Duct Shutoff Valve (See Figure 2.)

(1) An outer wing pneumatic duct shutoff valve is installed between the low-pressure pnematic manifold and the outer wing pneumatic duct.

(2) It is an electrically controlled, pneumatically actuated, poppet-type valve. The valve operates when the pneumatic manifold is pressurized



Outer Wing Pneumatic Duct Shutoff Valve -- Schematic
Figure 2

and electrical power is directed to the valve by either the airfoil deicing system or the anti-icing system.

(3) When electrical power is supplied to the open winding of the valve solenoid by one of the above systems, air pressure from the pneumatic system opens the valve. As long as pneumatic power is supplied, the valve remains open until the close winding of the valve solenoid is energized. When the valve opens, air from the pneumatic system is directed to the outer wing pneumatic duct. The duct supplies air to the outer wing deicing valves and to the outer wing vent scoop.

B. Tail Duct Valve (See Figure 3.)

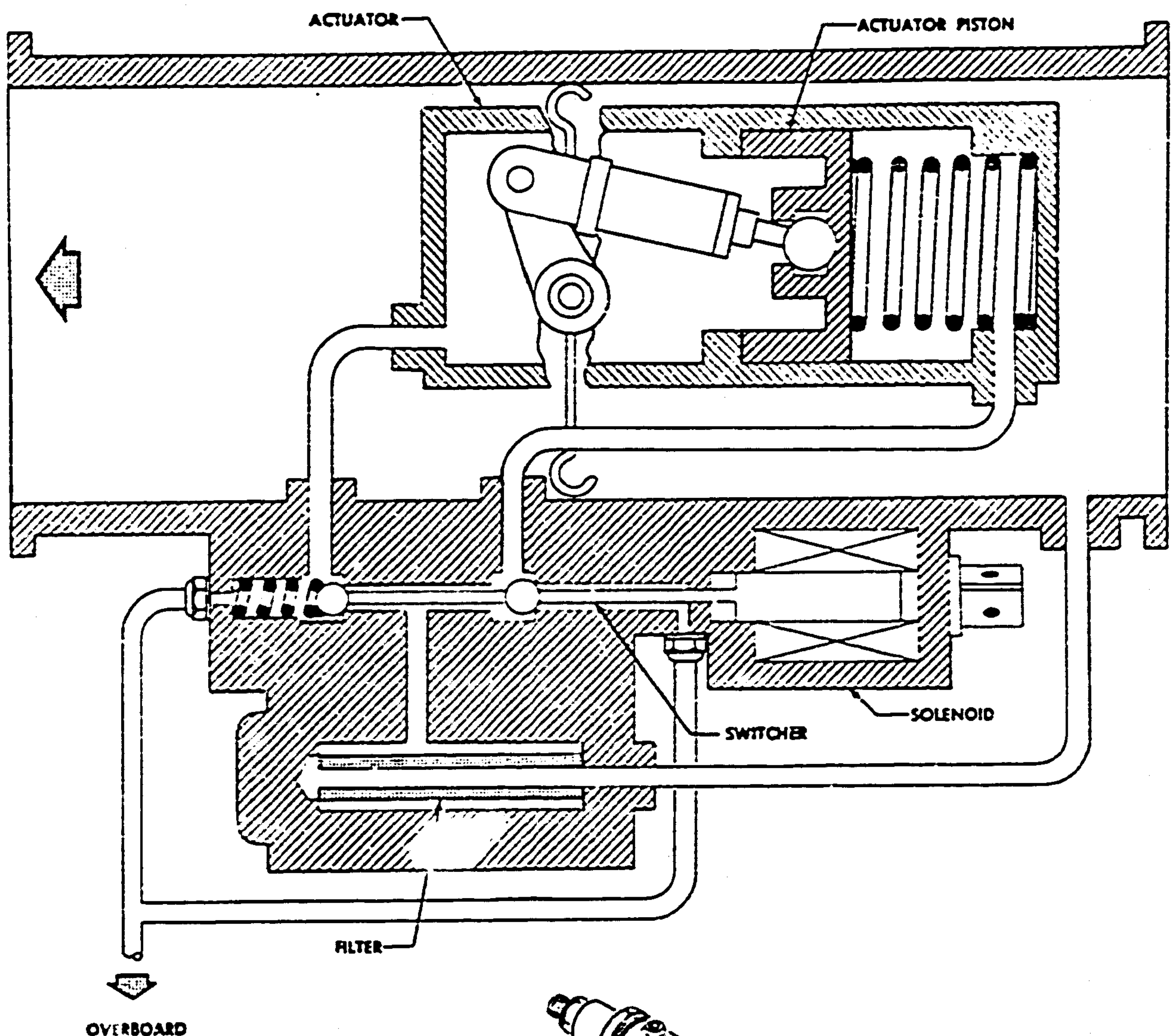
(1) The tail duct valve controls the air supply to the deicing and anti-icing ducts and components of the horizontal stabilizers. The valve is open only when the airfoil deicing system is operating. It is located in the forward end of the tail duct at the juncture of the wing and fuselage sections of the airplane pneumatic manifold (left side).

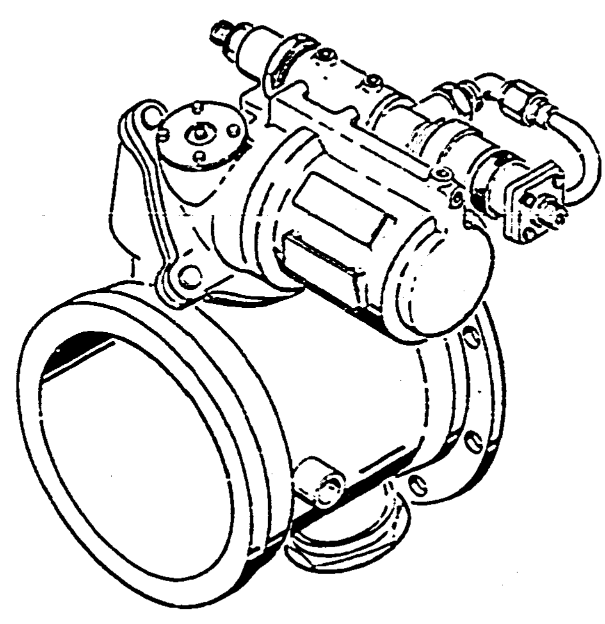
(2) The valve is an electrically controlled, pneumatically actuated butterfly valve, requiring both electrical and pneumatic power to open. The valve closes any time electrical power is removed from the solenoid, even in the absence of pneumatic power.

C. Airfoil Deicing Valve (See Figures 4 and 5.)

(1) Airfoil deicing valves are used in the deicing system to cycle air from the pneumatic ducts to the D-ducts that are located in the leading edge of the wings and stabilizer. The D-ducts are divided into sections and each section is supplied with air from the pneumatic duct system through a deicing valve. The valves are attached to the supply duct with V-band clamps and are connected to their respective D-duct section with a flexible connector and a band-type clamp. A total of 18 deicing valves are used in the system; six are used in each wing, and 6 in the horizontal stabilizer.

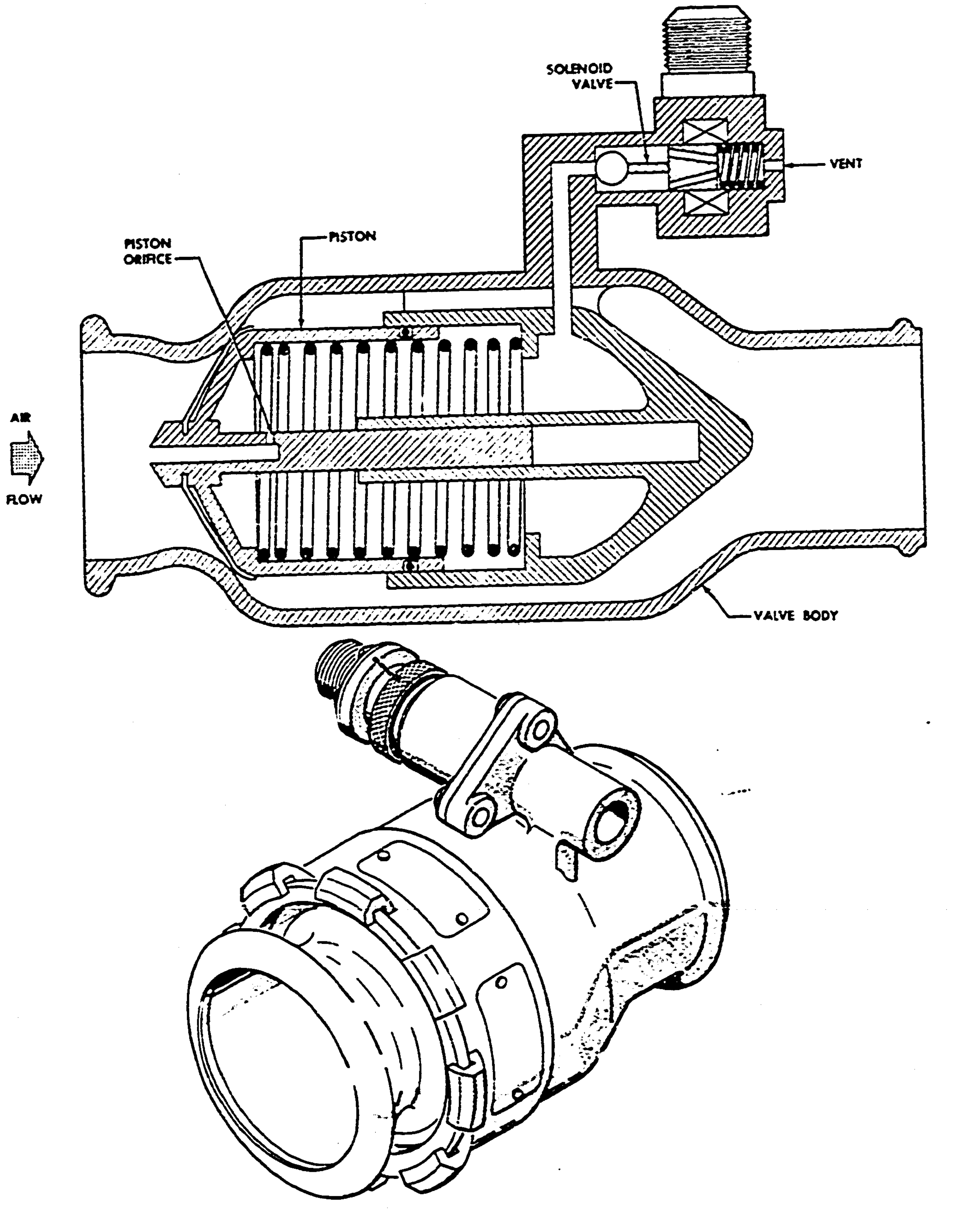
(2) In each wing, one valve is located between the fuselage and the inboard pylon to deice the wing slot area (inner-wing valve), two valves are located between the pylons (center-wing valves), and three valves are located outboard of the outboard pylons (outer-wing valves). All deicing valves are electrically controlled and pneumatically actuated. Air from the low-pressure pneumatic system is always available to the center-wing and inner-wing valves when the pneumatic manifold is pressurized. Air from the pneumatic system is available to the outer-wing valves and to the stabilizer when, during operation of the deicing or anti-icing system, the tail duct valve and the outer wing pneumatic duct shutoff valves are open. The valves return to the normally-closed position when electrical power is removed from the solenoid.



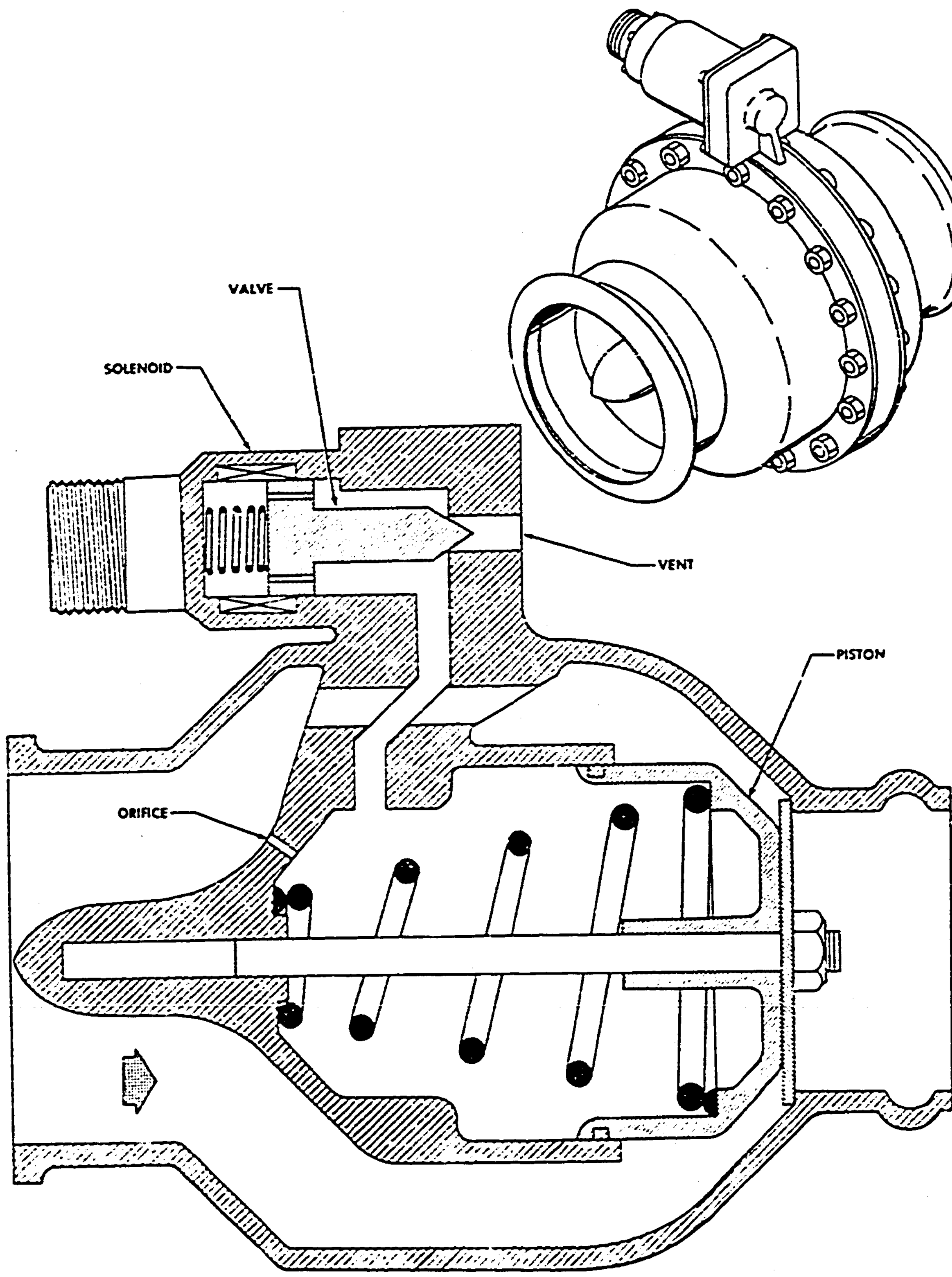


HA2-1577

Tail Duct Valve -- Schematic
Figure 3



Outer Wing Deicing Valve -- Schematic
Figure 4



Inner Wing Deicing Valve -- Schematic
Figure 5

D. Airfoil Deicing Timers (See Figure 6.)

(1) The airfoil deicing timers control the on-off cycling of the airfoil deicing valves. Two timers are mounted on the systems engineer's control panel. One timer acts as the standby while the other one is connected in the circuit through the airfoil deicing switch.

(2) The timers have an airfoil deicing timer cycle selector knob and an airfoil deicing timer temperature selector knob. The dial is graduated from 0° to -30°C for ram-air temperature selections. The switch-actuating camshaft in the timer is driven faster or slower by a variable speed drive that is controlled by the temperature selector knob. When the deicer timer selector knob is placed in the test position, the timer will go through the complete cycle in 23 to 31 seconds. The manually-set cycle selector knob determines cycle time according to the ram-air temperature indication. The cycle time can be doubled by pulling out and turning the cycle selector knob from the normal cycle to the long cycle position.

(3) A portion of a dial is seen through a window in the face of the timer. The number of the airfoil deicing valve that should be open at any given time appears in the window of the timer, with the exception of positions No. 11 and 12. These positions have no corresponding valves since the vertical stabilizer is not deiced.

E. Tail Duct Venturi Differential-Pressure Switch (See Figure 7.)

(1) The tail duct venturi differential-pressure switch is installed in the airfoil deicing system to operate an amber indicating light in the flight compartment. The differential-pressure switch, connected to the venturi downstream of the tail duct valve, senses any malfunction in the tail section that causes high airflow, and completes an electrical circuit to operate the indicating light. Differential-pressure across the tail duct venturi actuates a diaphragm to which the load contacts are connected.

3. Operation

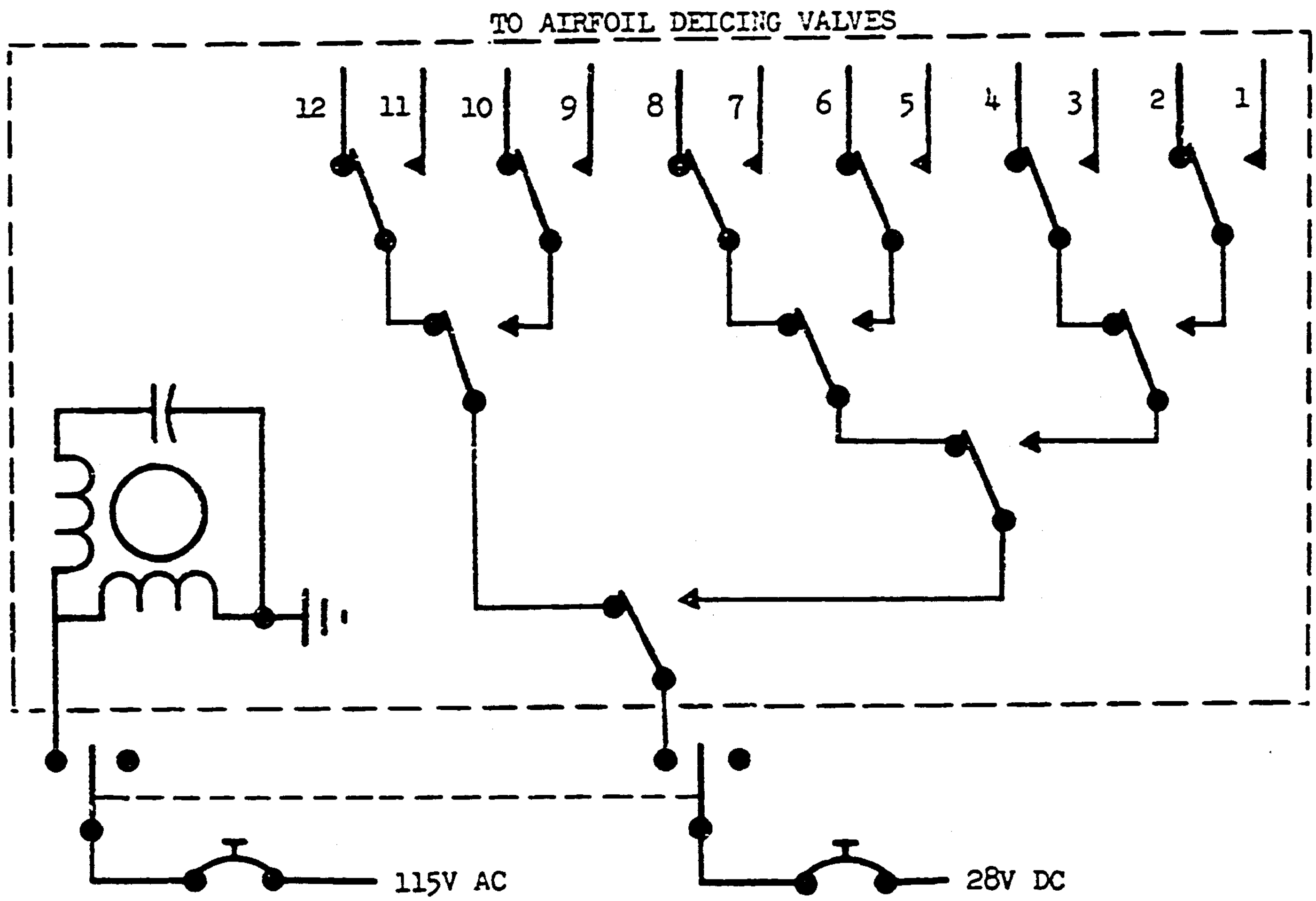
A. The airfoil deicing system is set in operation by placing the following controls in the noted position:

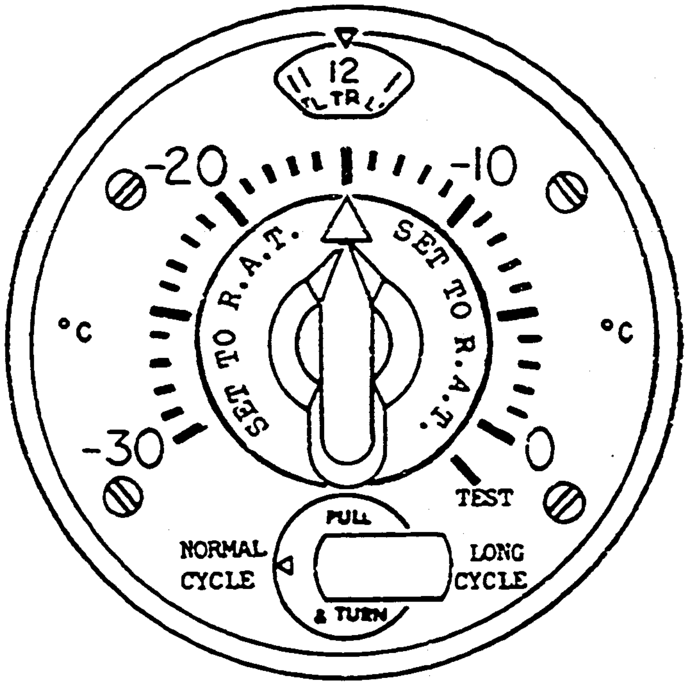
Tail duct valve switch. . . . . normal

Airfoil deicing timer cycle
selector knob . . . . normal cycle

Airfoil deicing timer temperature
selector knob . . . . at ram-air temperature

Airfoil deicing switch. . . . . timer 1 or timer 2.



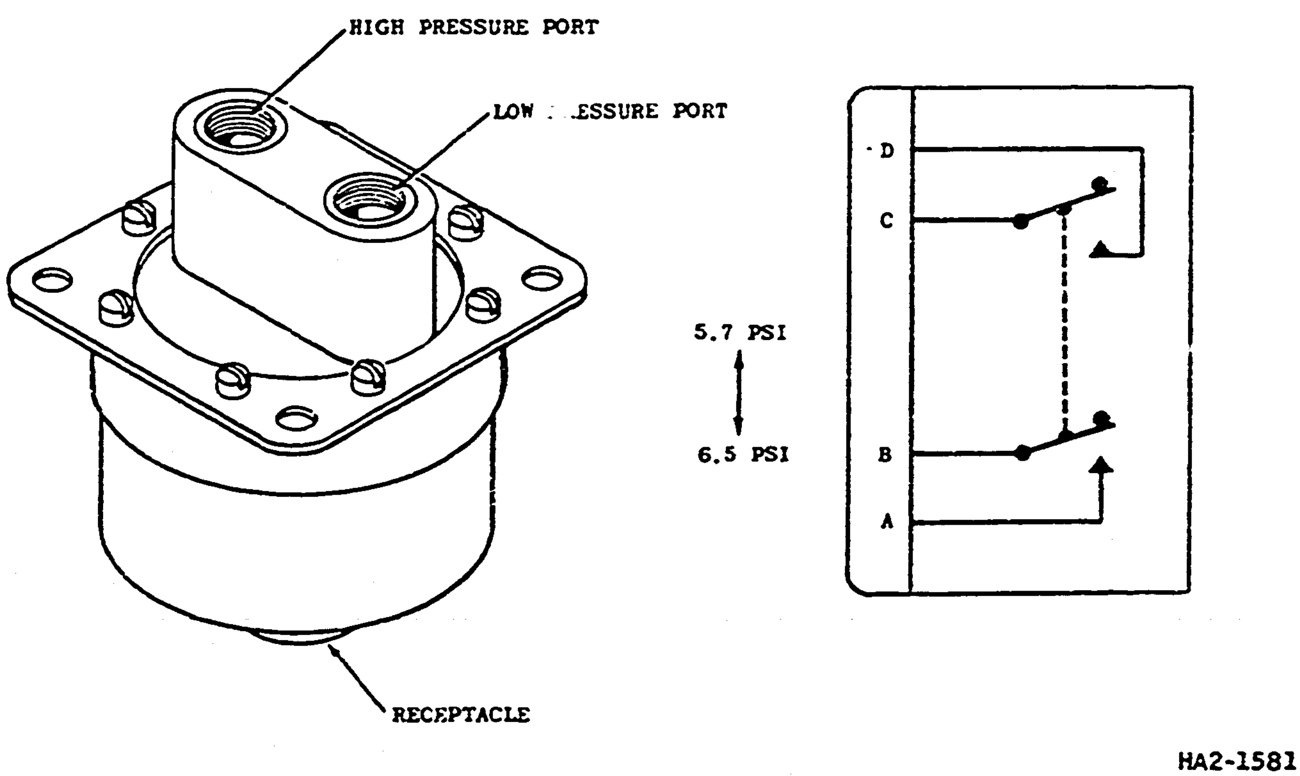


HA2-1580

Airfoil Deicing Timer -- Functional
Figure 6

NOTE: The deicing valves are deactivated on the ground through the operation of the left air-conditioning ground control relay. This feature is incorporated in the system to avoid overheating the structure. For ground operation, see Maintenance Practices, this section.

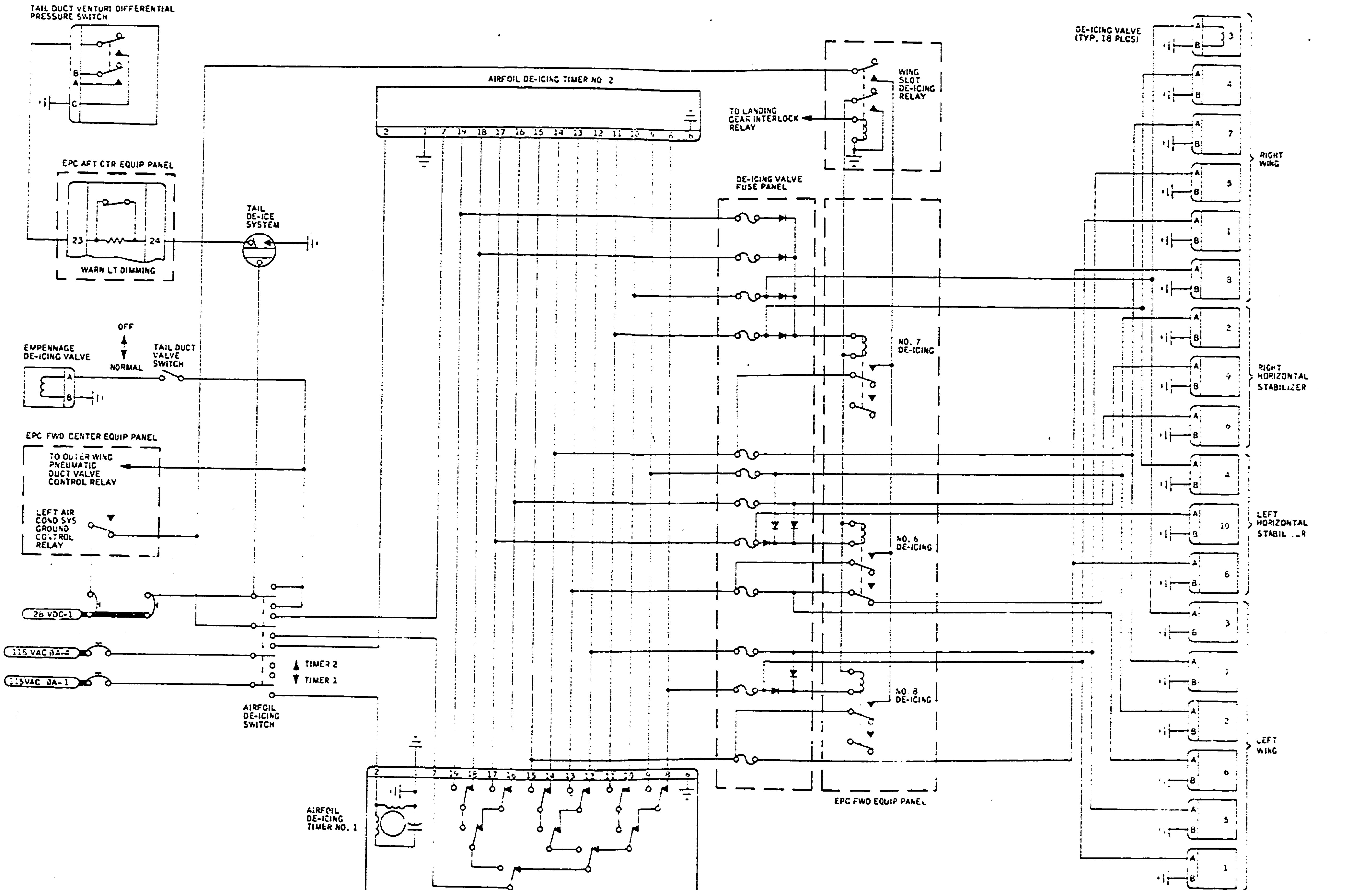
B. When the airfoil deicing switch is placed in timer 1 or timer 2 position, air from the supply ducts and the manifold is directed to the airfoil leading edges and wing leading edge slots through the deicing valves. These valves are electrically controlled by the selected timer to supply air to one or more sections of the D-duct in the leading edge of each airfoil. Through the action of the timer, air is supplied intermittently and in sequence to corresponding sections of the D-duct. This action electrically controls the opening and closing rate of the deicing valves. One deicing cycle is completed when all leading edge areas have received deicing air. This cycle is repeated until the airfoil deicing switch is placed in the off position.



Tail Duct Venturi Differential Pressure -- Switch
Figure 7

C. To prevent the formation of runback ice, and to shed secondary ice, an airfoil deicing timer cycle selector knob, is provided at the bottom of the timer dial for selecting a normal cycle or a long cycle. When the knob is positioned from normal cycle to long cycle prior to turning off the deicing system, the length of time that the deicing valves remain open is doubled. A small portion of a rotating dial is visible in a window at the top of the timer. The identifying number of the airfoil deicing valves that should be open at any given time appears in the window of the timer, with the exception of positions 11 and 12. These positions have no corresponding valves since the vertical stabilizer is not deiced. The letter adjacent to the number indicates the general location of the valves; for example, L for left wind, R for right wing, and T for tail.

D. During approach and landing operations, it is necessary that the wing slot areas be deiced more frequently than the unslotted areas. When the landing gear control lever is placed in the down position, the slotted area deicing valves open for three extra intervals during the same time that all the valves are operating in their regular sequence. With the landing gear control lever in this position, the fuselage nose anti-icing valves are locked closed to conserve engine bleed air.



Airfoil Deicing System -- Electrical Schematic
Figure 8 (Sheet 1)

AIRFOIL - DESCRIPTION AND OPERATION

1. General

   A. The airfoil deicing system removes ice from the leading edges of the wing, the leading edges of the wing slots, the wing slots lower doors, and the leading edges of the horizontal stabilizer. Hot air from the pneumatic system is distributed to the leading edges through a system of ducts and by electrically controlled, pneumatically operated valves.

   B. Fourteen deicing valves, 12 of which are operated in pairs by either one of two timers, permit intermittent airflow to the deicing segments.

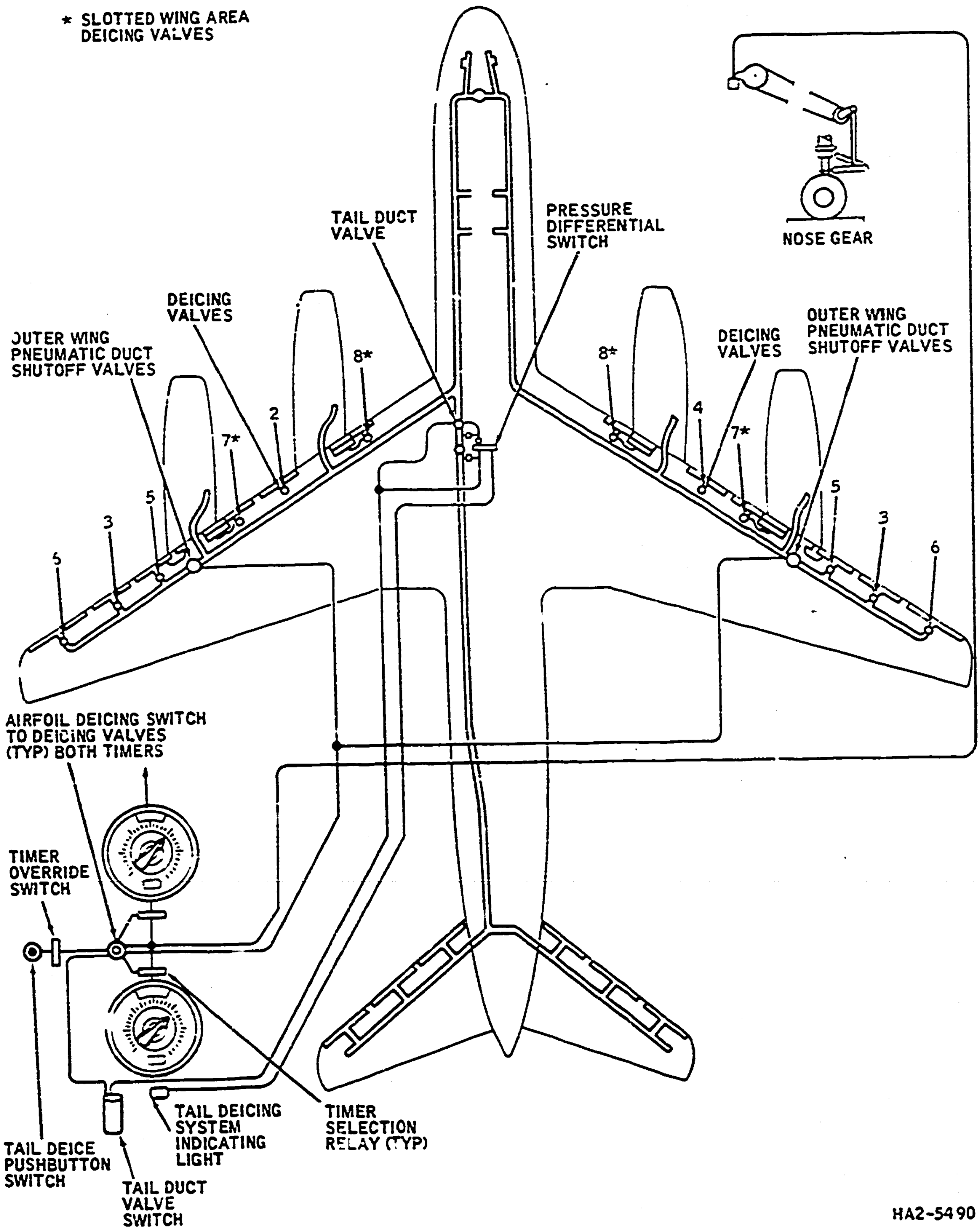
   C. An interlock wing slot deice relay is actuated when the landing gear control lever is placed in the down position. This permits a triple-cycle feature to deice the slotted wing sections approximately three times as often as the wing sections without slots.

   D. Controls for the system are located on the system engineer's control panel. They include the airfoil deicing switch, two identical timers, a guarded tail duct valve switch, tail deice switch, timer override switch and a tail deicing system indicating light. The system is electrically interlocked with the ground control relay circuit so that the deicing valves cannot be operated on the ground.

   E. The deicing timer motors, the tail duct valve, and the outer wing pneumatic duct shutoff valves are independent of the ground control relay.

   F. Air directed to the center and inner wing leading edges (inboard of No. 1 and 4 pylons) is supplied directly by the pneumatic manifold. From the low-pressure pneumatic manifold, air is directed to the left and right outer wings (outboard of No. 1 and 4 pylons) through the outer wing pneumatic duct shutoff valves, and to the empennage through the tail duct valve and the tail duct. The tail duct extends from the tail duct valve in the fuselage to the tail section of the airplane. This duct is located on the left side of the fuselage below the floor, in the pressurized area, and extends into the horizontal stabilizer. D-ducts in the leading edge of each airfoil are divided into a total of 18 sections and direct the distribution of air through the leading edge areas to be deiced. All D-ducts are riveted to ribs located in the wing and stabilizer leading edges, and are removed and installed as integral components of the leading edge structure (see Chapters 55 and 57). The deicing air exhausts overboard from the wing leading edges through slots in the lower surface between pylons. Air from the horizontal stabilizer leading edges exhausts into the tail cone and overboard through slots in the tail cone, the elevator torque tube, and the horizontal stabilizer torque box.

   G. V-band clamps and flexible connectors connect the tail duct sections. The flexible connectors in the pressurized area are a double-walled type, similar to the connectors used in the pneumatic manifold (see Chapter 36) with the exception of the attaching flanges. The connectors in the



Airfoil Deicing System -- Schematic
Figure 1

nonpressurized area (tail section) are a single-walled type attached to the beaded ends of the duct with clamps.

H. The tail duct directs air to the horizontal stabilizer. A Y-duct in the horizontal stabilizer with a flexible connector located at the pivot of the stabilizer allows the duct to flex with stabilizer movement. The ducts in the stabilizer leading edge have three deicing ports on each side of the stabilizer. A bleed orifice is located near the outboard end of the ducts. Air from the tail duct bleeds into the leading edge area from these orifices, ensuring a hot air supply to all tail deicing flow-limiting orifices when the tail duct valve is open.

I. A flow-limiting venturi, located just downstream of the tail duct valve, provides a pressure signal for the tail duct valve differential-pressure switch. Two sensing lines are connected across the venturi, one at the throat and one immediately upstream of the venturi.

J. The outer wing ducts extend from the outer wing pneumatic duct shutoff valves, connected to the pneumatic manifold (outboard of No. 1 and 4 pylons), to the wing tips. An anti-icing air outlet is located near the outboard end of each duct. The two ducts are composed of sections connected with clamps and single-wall flexible connectors. Each section is supported by a fixed and slip-type bracket. The fixed bracket holds the duct section rigid where the deicing valves attach to the deicing air outlets. The slip supports allow the duct to expand and contract, and also allow for structural deflections.

K. The airfoil deicing controls and indicating light system provides for electrical control and monitoring of the deicing of the wing and tail surfaces. The system controls and indicating light are located on the systems engineer's control panel and include the following:

(1) Airfoil deicing switch, with timer 1--off--timer 2 positions

(2) Two airfoil timers (these also act as cycle sequence indicators for wing deicing valves)

(3) Tail deicing pushbutton (to cycle tail duct valve for 150 seconds)

(4) Tail deicing system indicating light

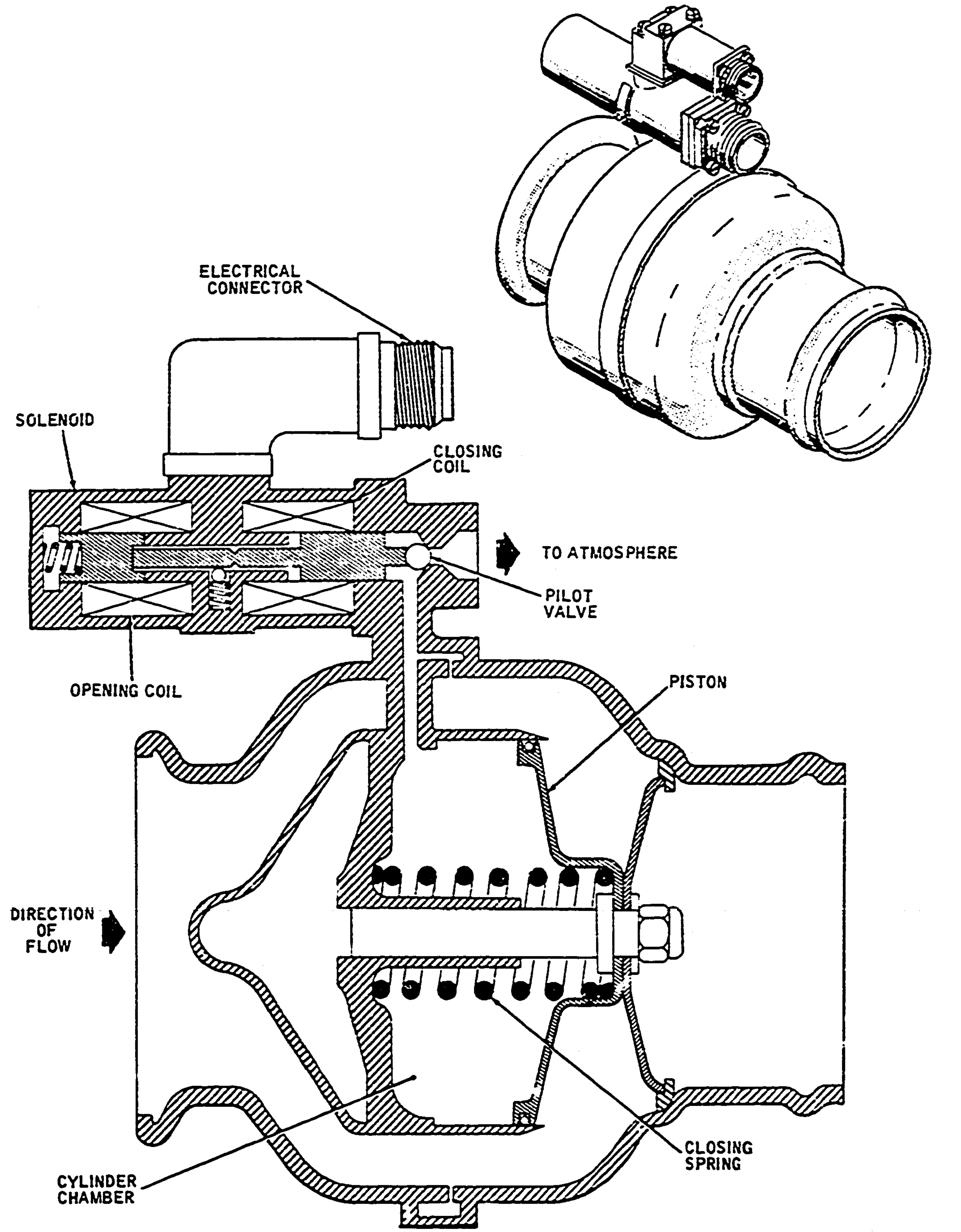
(5) Tail duct valve switch, with normal--off positions

(6) Timer override switch, with normal--timer override positions.

2. Component Description

A. Outer Wing Pneumatic Duct Shutoff Valve (See Figure 2.)

(1) An outer wing pneumatic duct shutoff valve is installed between the low-pressure pneumatic manifold and the outer wing pneumatic duct.



Outer Wind Pneumatic Duct Shutoff Valve -- Schematic
Figure 2

(2) It is an electrically controlled, pneumatically actuated, poppet-type valve. The valve operates when the pneumatic manifold is pressurized and electrical power is directed to the valve by either the airfoil deicing system or the anti-icing system.

(3) When electrical power is supplied to the open winding of the valve solenoid by one of the above systems, air pressure from the pneumatic system opens the valve. As long as pneumatic power is supplied, the valve remains open until the close winding of the valve solenoid is energized. When the valve opens, air from the pneumatic system is directed to the outer wing pneumatic duct. The duct supplies air to the outer wing deicing valves and to the outer wing vent scoop.

B. Tail Duct Valve (See Figure 3.)

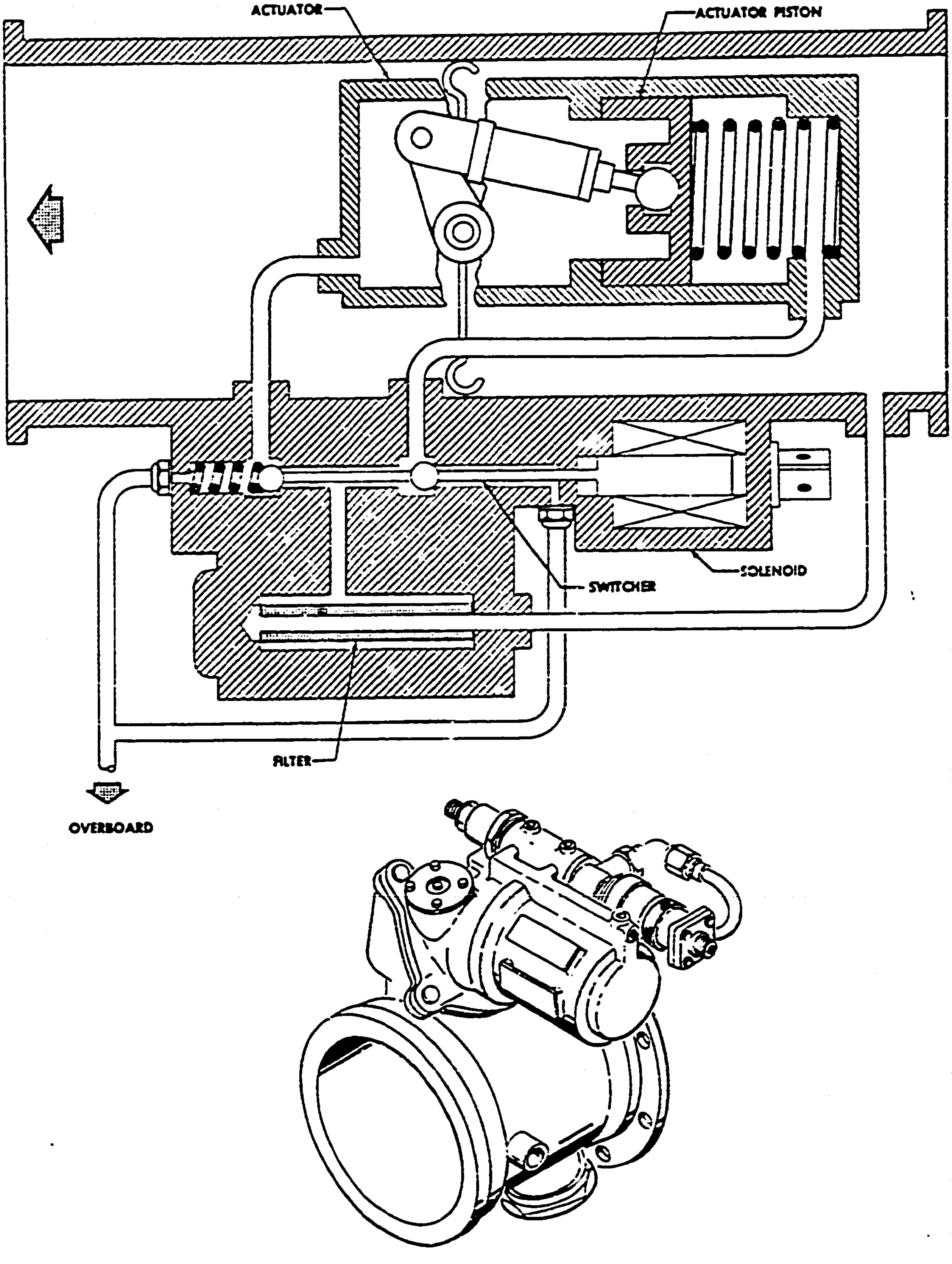
(1) The tail duct valve controls the air supply to the deicing and anti-icing ducts and components of the horizontal stabilizers. The valve is open only when the airfoil deicing system is operating. It is located in the forward end of the tail duct at the juncture of the wing and fuselage sections of the airplane pneumatic manifold (left side).

(2) The valve is an electrically controlled, pneumatically actuated butterfly valve, requiring both electrical and pneumatic power to open. The valve closes any time electrical power is removed from the solenoid, even in the absence of pneumatic power.

C. Airfoil Deicing Valve (See Figures 4 and 5.)

(1) Airfoil deicing valves are used in the deicing system to cycle air from the pneumatic ducts to the D-ducts that are located in the leading edge of the wings. The D-ducts are divided into sections and each section is supplied with air from the pneumatic duct system through a deicing valve. The valves are attached to the supply duct with V-band clamps and are connected to their respective D-duct section with a flexible connector and a band-type clamp. A total of 12 deicing valves are used in the system; six in each wing.

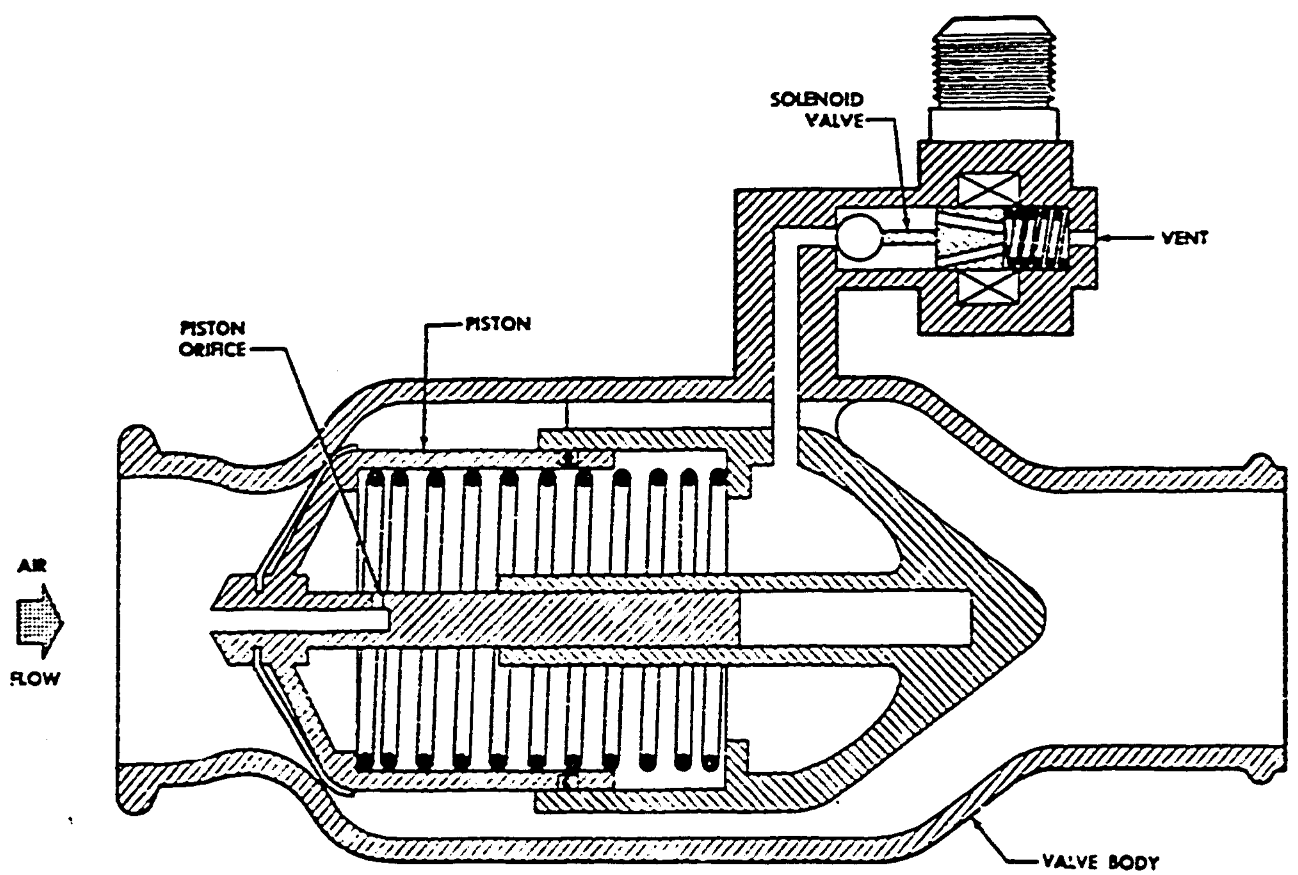
(2) In each wing, one valve is located between the fuselage and the inboard pylon to deice the wing slot area (inner-wing valve), two valves are located between the pylons (center-wing valves), and three valves are located outboard of the outboard pylons (outer-wing valves). All deicing valves are electrically controlled and pneumatically actuated. Air from the low-pressure pneumatic system is always available to the center-wing and inner-wing valves when the pneumatic manifold is pressurized. Air from the pneumatic system is available to the outer-wing valves and to the stabilizer valves when, during operation of the deicing or anti-icing system, the tail duct valve and the outer wing pneumatic duct shutoff valves are open. The valves return to the normally-closed position when electrical power is removed from the solenoid.

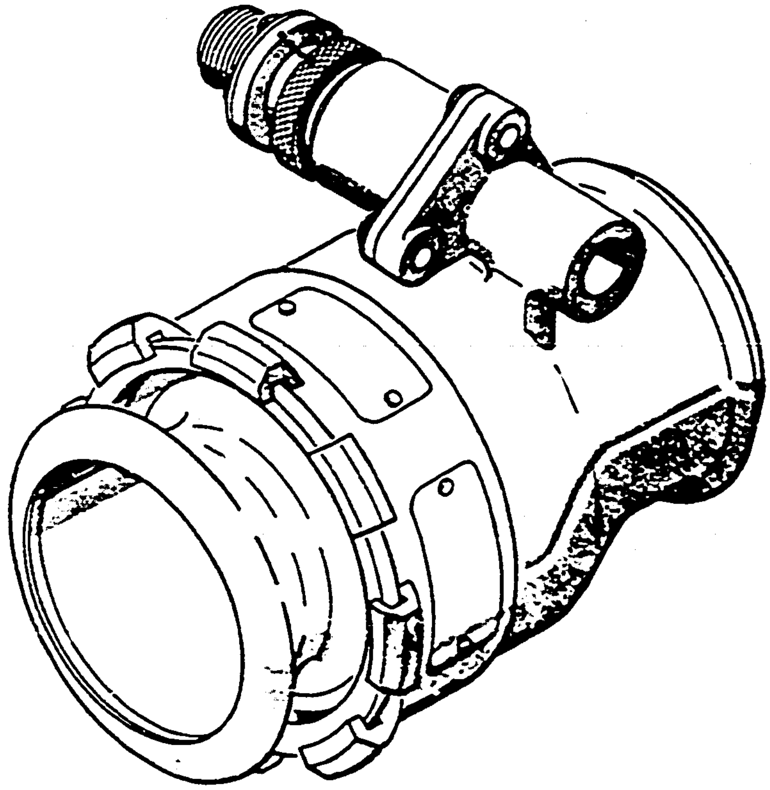


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Tail Duct Valve -- Schematic
Figure 3

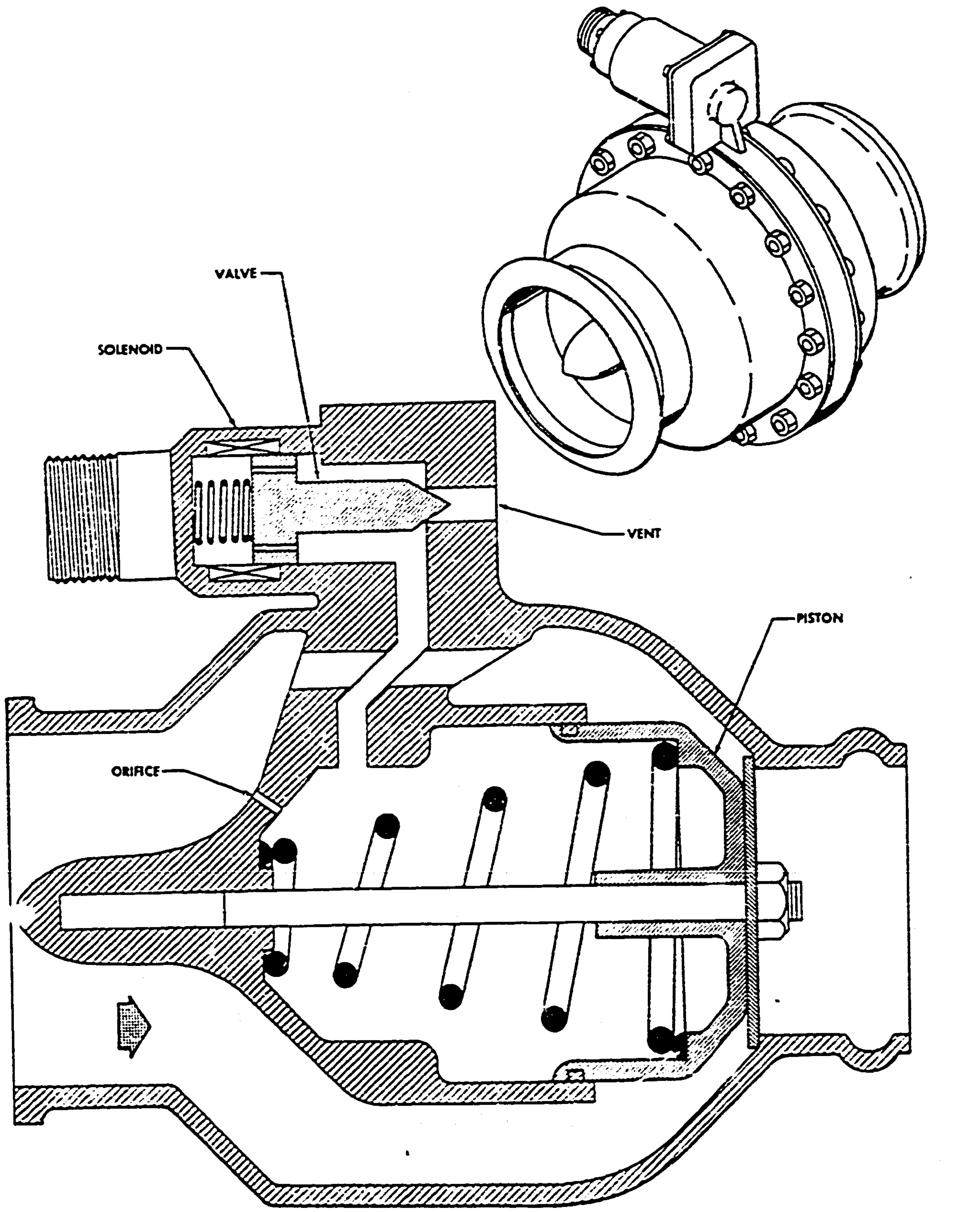
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Outer Wing Deicing Valve -- Schematic
Figure 4



Inner Wing Deicing Valve -- Schematic
Figure 5

D. Airfoil Deicing Timers (See Figure 6.)

(1) The airfoil deicing timers control the on-off cycling of the airfoil deicing valves. Two timers are mounted on the systems engineer's control panel. One timer acts as the standby while the other one is connected in the circuit through the airfoil deicing switch.

(2) The timers have an airfoil deicing timer cycle selector knob and an airfoil deicing timer temperature selector knob. The dial is graduated from 0° to -30°C for ram-air temperature selections. The switch-actuating camshaft in the timer is driven faster or slower by a variable speed drive that is controlled by the temperature selector knob. When the deicer timer selector knob is placed in the test position, the timer will go through the complete cycle in 23 to 31 seconds. The manually-set cycle selector knob determines cycle time according to the ram-air temperature indication. The cycle time can be doubled by pulling out and turning the cycle selector knob from the normal cycle to the long cycle position.

(3) A portion of a dial is seen through a window in the face of the timer. The number of the airfoil deicing valve that should be open at any given time appears in the window of the timer

E. Tail Duct Venturi Differential-Pressure Switch (See Figure 7.)

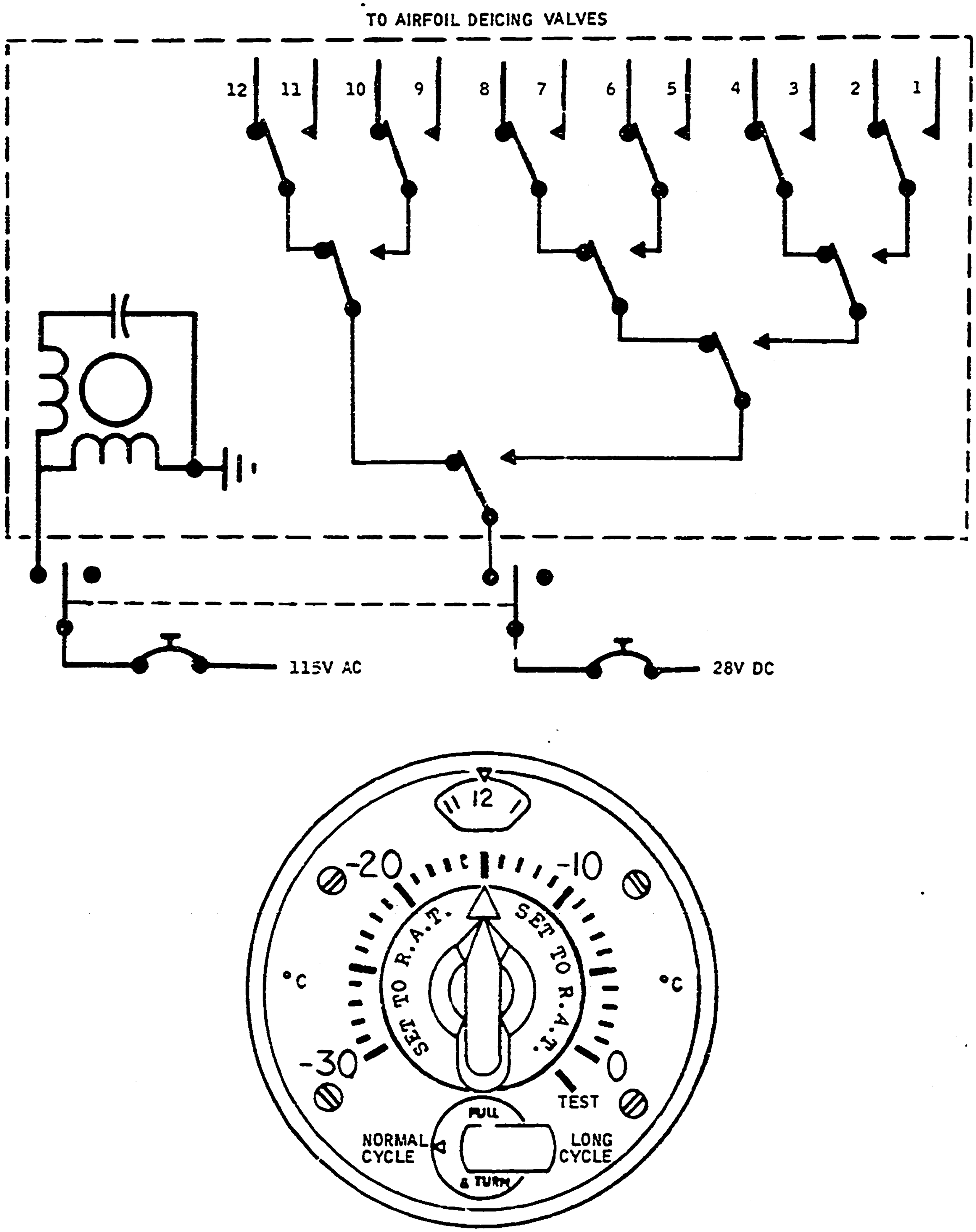
(1) The tail duct venturi differential-pressure switch is installed in the airfoil deicing system to operate an amber indicating light in the flight compartment. The differential-pressure switch, connected to the venturi downstream of the tail duct valve, senses any malfunction in the tail section that causes low airflow, and completes an electrical circuit to operate the indicating light. Differential-pressure across the tail duct venturi actuates a diaphragm to which the load contacts are connected.

3. <u>Operation</u>

A. The airfoil deicing system is set in operation by placing the following controls in the noted position:

Tail duct valve switch. . . . . normal

Airfoil deicing timer cycle
selector knob . . . . normal cycle



HA2-2072

Airfoil Deicing Timer -- Functional
Figure 6

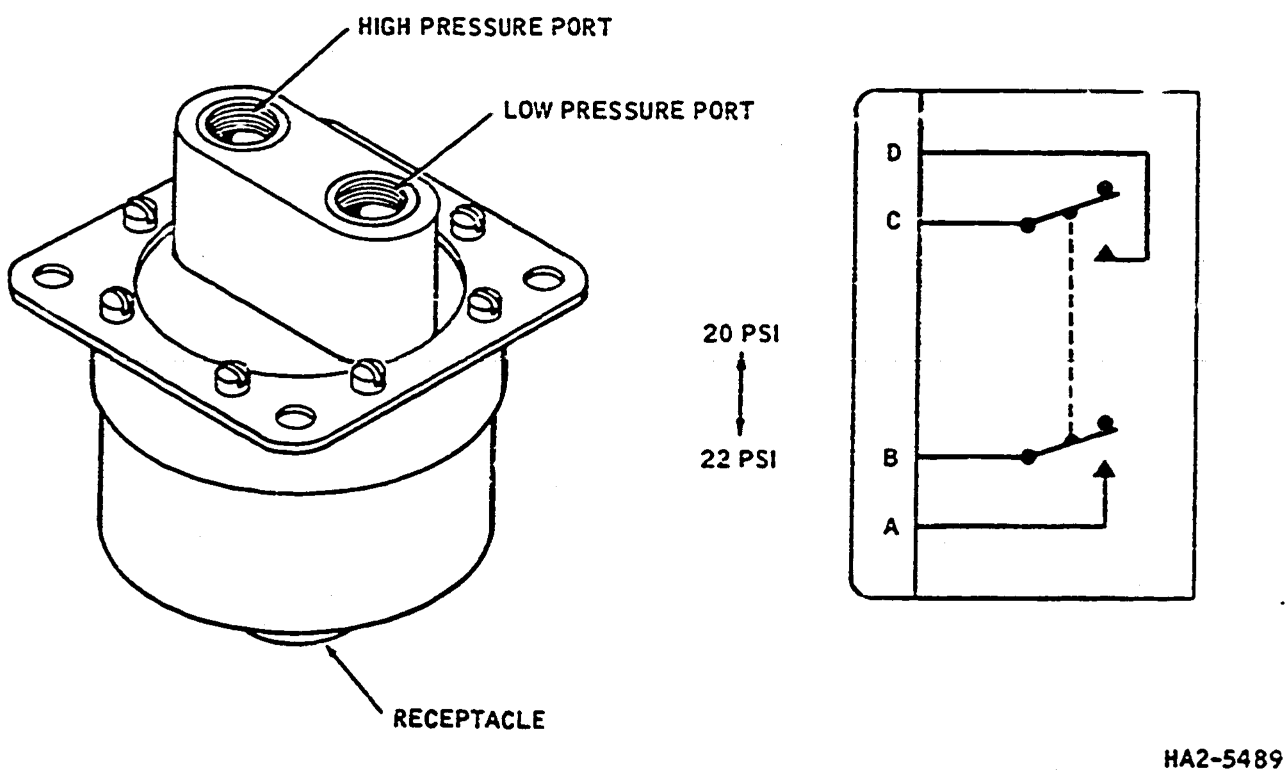
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Airfoil deicing timer temperature selector knob . . . . at ram-air temperature

Airfoil deicing switch. . . . . timer 1 or timer 2.

NOTE: The deicing valves are deactivated on the ground through the operation of the left air-conditioning ground control relay. This feature is incorporated in the system to avoid overheating the structure. For ground operation, see Maintenance Practices, this section.

B. When the airfoil deicing switch is placed in timer 1 or timer 2 position, air from the supply ducts and the manifold is directed to the airfoil leading edges and wing leading edge slots through the deicing valves. These valves are electrically controlled by the selected timer to supply air to one or more sections of the D-duct in the leading edge of each airfoil. Through the action of the timer, air is supplied intermittently and in sequence to corresponding sections of the D-duct. This action electrically controls the opening and closing rate of the deicing valves. One deicing cycle is completed when all wing leading edge areas have received deicing air. This cycle is repeated until the airfoil deicing switch is placed in the off position.



Tail Duct Venturi Differential Pressure -- Switch
Figure 7

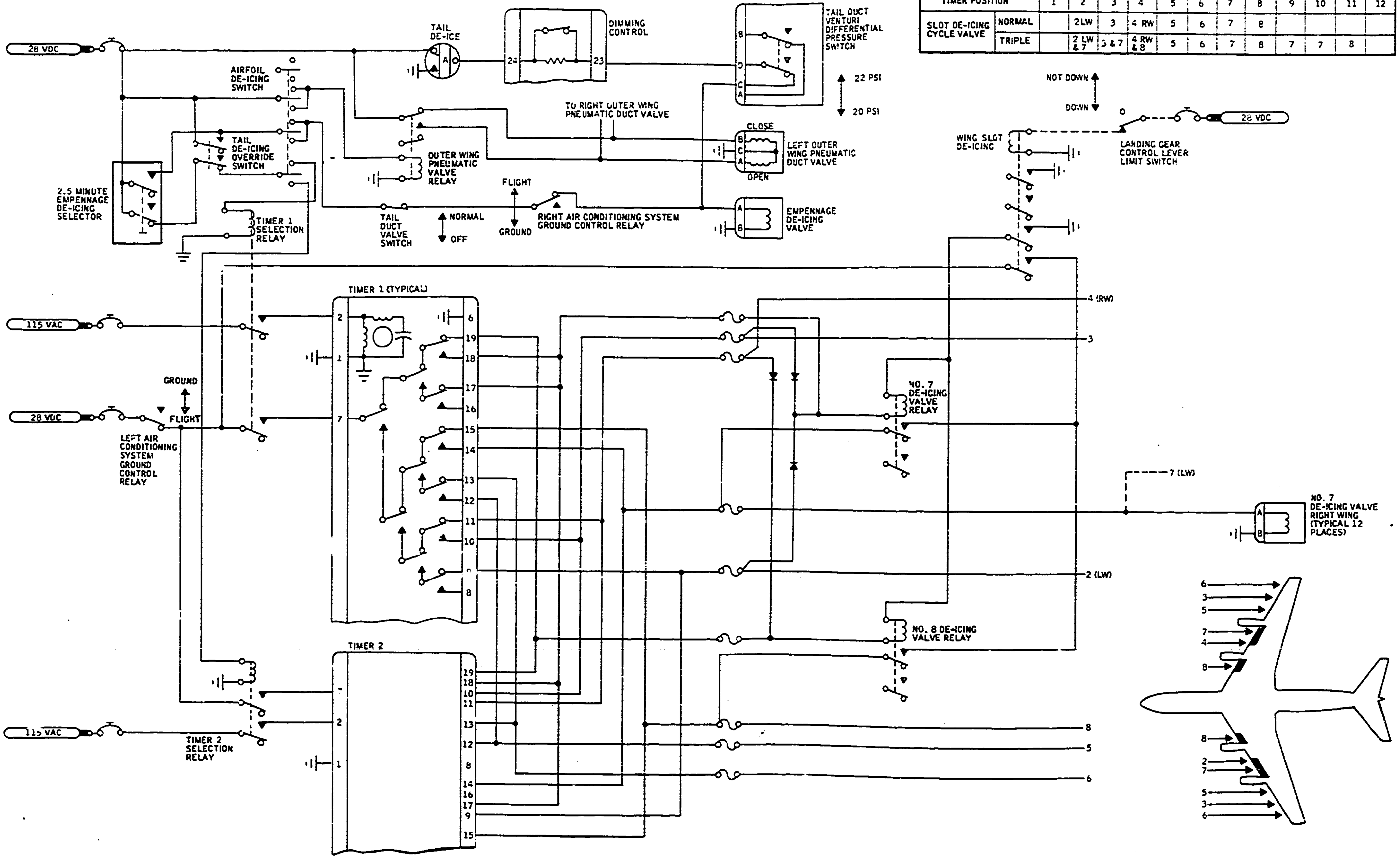
Printed in U.S.A.

C. To prevent the formation of runback ice, and to shed secondary ice, an airfoil deicing timer cycle selector knob, is provided at the bottom of the timer dial for selecting a normal cycle or a long cycle. When the knob is positioned from normal cycle to long cycle prior to turning off the deicing system, the length of time that the deicing valves remain open is doubled. A small portion of a rotating dial is visible in a window at the top of the timer. The identifying number of the airfoil deicing valves that should be open at any given time appears in the window of the timer, with the exception of positions 1 and 9 through 12. These positions have no corresponding valves. The letter adjacent to the number indicates the general location of the valves; for example, L for left wing and R for right wing.

D. During approach and landing operations, it is necessary that the wing slot areas be deiced more frequently than the unslotted areas. When the landing gear control lever is placed in the down position, the slotted area deicing valves open for three extra intervals during the same time that all the valves are operating in their regular sequence. With the landing gear control lever in this position, the fuselage nose anti-icing valves are locked closed to conserve engine bleed air.

E. Deicing of the horizontal stabilizer leading edges can be accomplished by one of two methods. When the airfoil deicing switch is in the timer 1 or timer 2 position, the tail deice switch can be pressed momentarily to start a tail deicing cycle which will last for approximately 150 seconds or the timer override switch can be held in the timer override position. Either method stops the timer operation, energizes the tail deicing valve which opens and allows hot air to flow to the tail deicing ports. If the tail deicing switch is pressed at any time during the 150-second cycle a new 150-second cycle will begin. When using the timer override switch, air flow to the tail will continue as long as the switch is held in the timer override position.

TIMER POSITION		1	2	3	4	5	6	7	8	9	10	11	12
SLOT DE-ICING CYCLE VALVE	NORMAL		2LW	3	4 RW	5	6	7	8				
	TRIPLE		2 LW & 7	3 & 7	4 RW & 8	5	6	7	8	7	7	8	



Airfoil Deicing System -- Electrical Schematic
Figure 8

AIRFOIL - DESCRIPTION AND OPERATION

1. General

A. The airfoil deicing system removes ice from the leading edges of the wing, the leading edges of the wing slots, the wing slots lower doors, and the leading edges of the horizontal stabilizer. Hot air from the low-pressure pneumatic system is distributed to the leading edges through a system of ducts and by electrically controlled, pneumatically operated valves.

B. Fourteen deicing valves, 12 of which are operated in pairs by either one of two timers, permit intermittent airflow to the deicing segments.

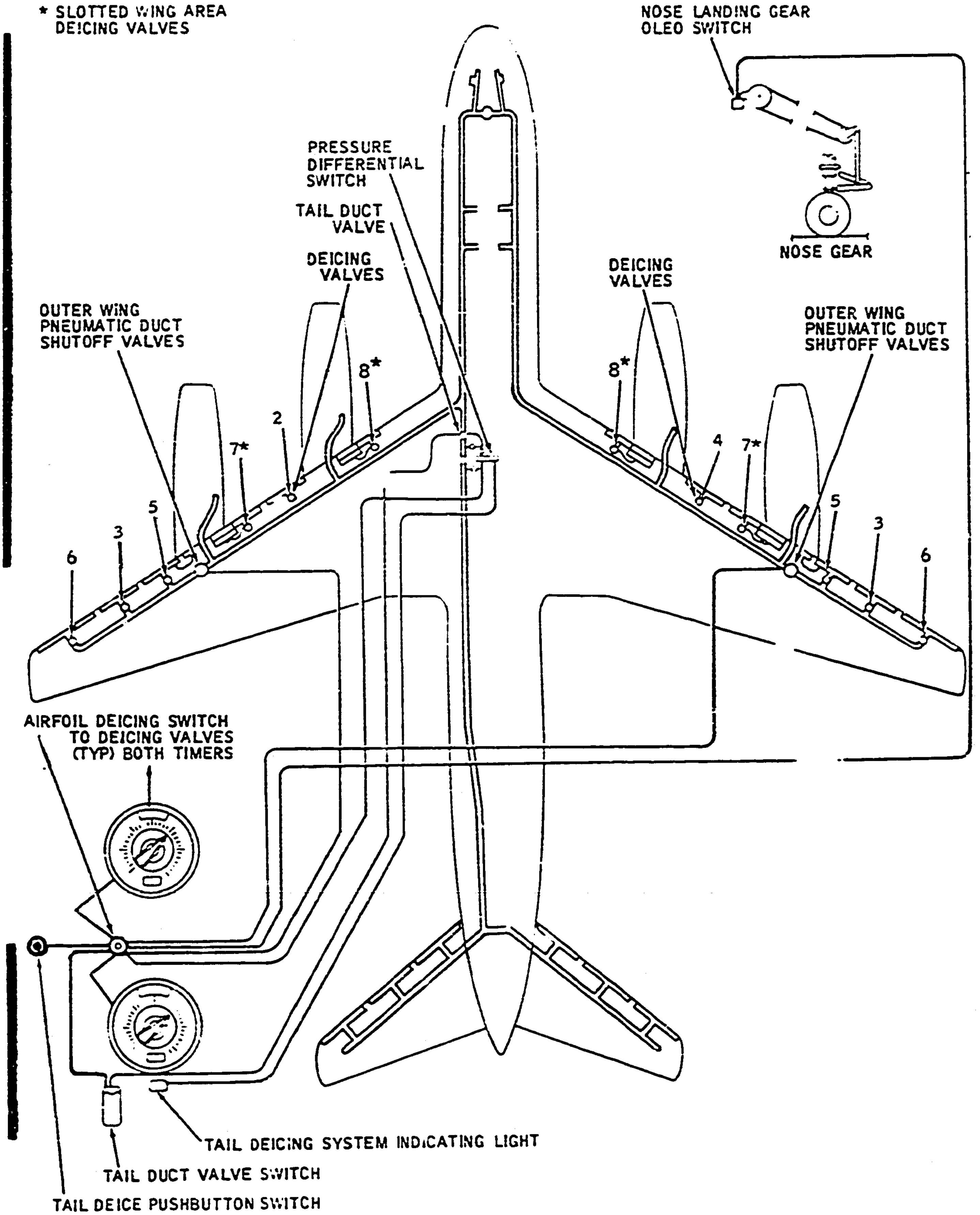
C. An interlock wing slot deice relay is actuated when the landing gear control lever is placed in the down position. This permits a triple-cycle feature to deice the slotted wing sections approximately three times as often as the wing sections without slots.

D. Controls for the system are located on the system engineer's control panel. They include the airfoil deicing switch, two identical timers, a guarded tail duct valve switch, tail deice pushbutton, and a tail deicing system indicating light. The system is electrically interlocked with the ground control relay circuit so that the deicing valves cannot be operated on the ground.

E. The deicing timer motors, the tail duct valve, and the outer wing pneumatic duct shutoff valves are independent of the ground control relay.

F. Air directed to the center and inner wing leading edges (inboard of No. 1 and 4 pylons) is supplied directly by the pneumatic manifold. From the low-pressure pneumatic manifold, air is directed to the left and right outer wings (outboard of No. 1 and 4 pylons) through the outer wing pneumatic duct shutoff valves, and to the empennage through the tail duct valve and the tail duct. The tail duct extends from the tail duct valve in the fuselage to the tail section of the airplane. This duct is located on the left side of the fuselage below the floor, in the pressurized area, and extends into the horizontal stabilizer. D-ducts in the leading edge of each airfoil are divided into a total of 18 sections and direct the distribution of air through the leading edge areas to be deiced. All D-ducts are riveted to ribs located in the wing and stabilizer leading edges, and are removed and installed as integral components of the leading edge structure (see Chapters 55 and 57). The deicing air exhausts overboard from the wing leading edges through slots in the lower surface between pylons. Air from the horizontal stabilizer leading edges exhausts into the tail cone and overboard through slots in the tail cone, the elevator torque tube, and the horizontal stabilizer torque box.

G. V-band clamps and flexible connectors connect the tail duct sections. The flexible connectors in the pressurized area are a double-walled type, similar to the connectors used in the pneumatic manifold (see Chapter 36)



Airfoil Deicing System -- Schematic
Figure 1

with the exception of the attaching flanges. The connectors in the nonpressurized area (tail section) are a single-walled type attached to the beaded ends of the duct with clamps.

H. The tail duct directs air to the horizontal stabilizer. A Y-duct in the horizontal stabilizer with a flexible connector located at the pivot of the stabilizer allows the duct to flex with stabilizer movement. The ducts in the stabilizer leading edge have three deicing ports on each side of the stabilizer. A bleed orifice is located near the outboard end of the ducts. Air from the tail duct bleeds into the leading edge area from these orifices, ensuring a hot air supply to all tail deicing flow-limiting orifices when the tail duct valve is open.

I. A flow-limiting venturi, located just downstream of the tail duct valve, provides a pressure signal for the tail duct valve differential-pressure switch. Two sensing lines are connected across the venturi, one at the throat and one immediately upstream of the venturi.

J. The outer wing ducts extend from the outer wing pneumatic duct shutoff valves, connected to the pneumatic manifold (outboard of No. 1 and 4 pylons), to the wing tips. An anti-icing air outlet is located near the outboard end of each duct. The two ducts are composed of sections connected with clamps and single-wall flexible connectors. Each section is supported by a fixed and slip-type bracket. The fixed bracket holds the duct section rigid where the deicing valves attach to the deicing air outlets. The slip supports allow the duct to expand and contract, and also allow for structural deflections.

K. The airfoil deicing controls and indicating light system provides for electrical control and monitoring of the deicing of the wing and tail surfaces. The system controls and indicating light are located on the systems engineer's control panel and include the following:

(1) Airfoil deicing switch, with timer 1--off--timer 2 positions

(2) Two airfoil timers (these also act as cycle sequence indicators for wing deicing valves)

(3) Tail deicing pushbutton (to cycle tail duct valve for 150 seconds)

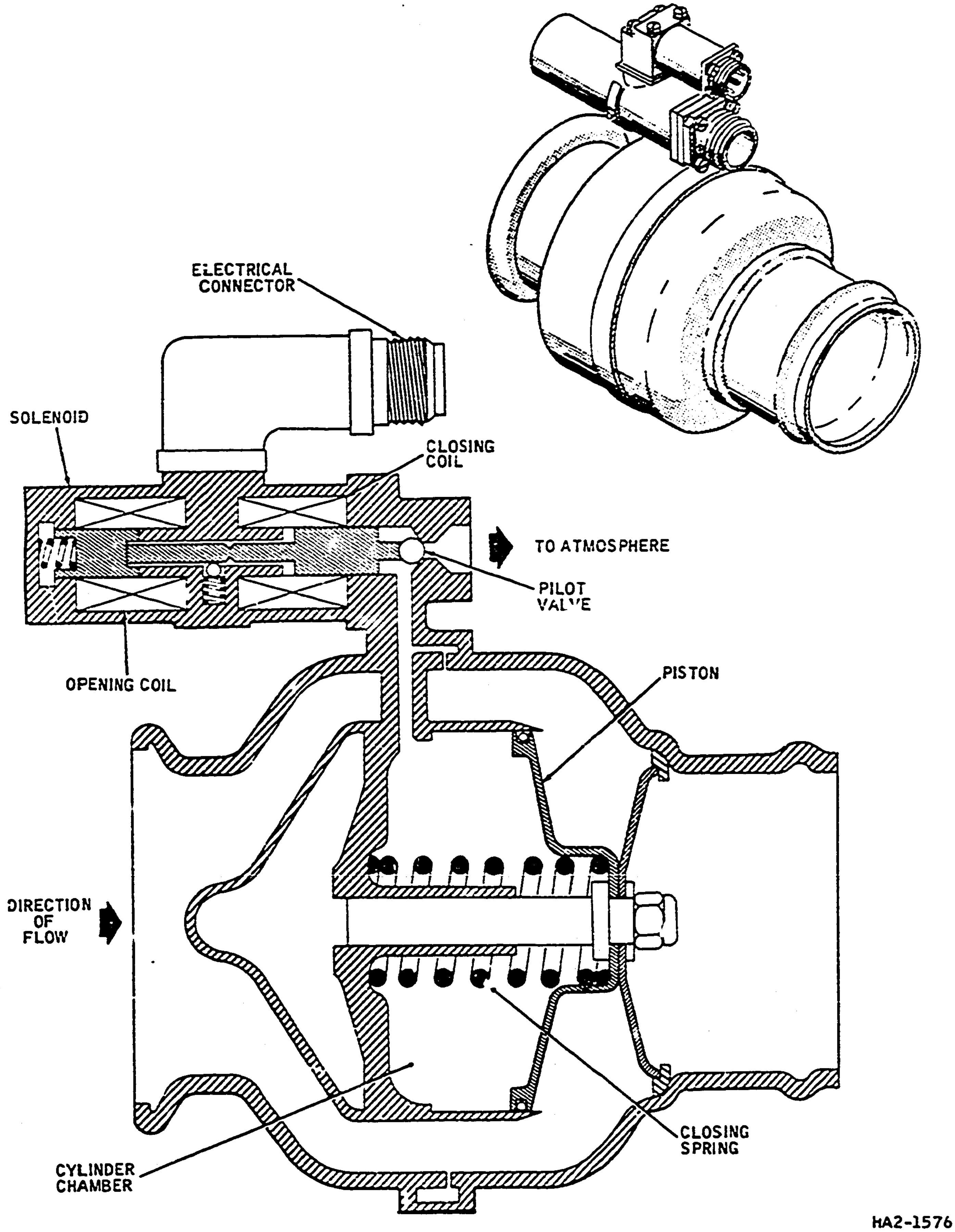
(4) Tail deicing system indicating light

(5) Tail duct valve switch, with normal--off positions.

2. Component Description

A. Outer Wing Pneumatic Duct Shutoff Valve (See Figure 2.)

(1) An outer wing pneumatic duct shutoff valve is installed between the low-pressure pneumatic manifold and the outer wing pneumatic duct.



Outer Wind Pneumatic Duct Shutoff Valve -- Schematic
Figure 2

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(2) It is an electrically controlled, pneumatically actuated, poppet-type valve. The valve operates when the pneumatic manifold is pressurized and electrical power is directed to the valve by either the airfoil deicing system or the anti-icing system.

(3) When electrical power is supplied to the open winding of the valve solenoid by one of the above systems, air pressure from the pneumatic system opens the valve. As long as pneumatic power is supplied, the valve remains open until the close winding of the valve solenoid is energized. When the valve opens, air from the pneumatic system is directed to the outer wing pneumatic duct. The duct supplies air to the outer wing deicing valves and to the outer wing vent scoop.

B. Tail Duct Valve (See Figure 3.)

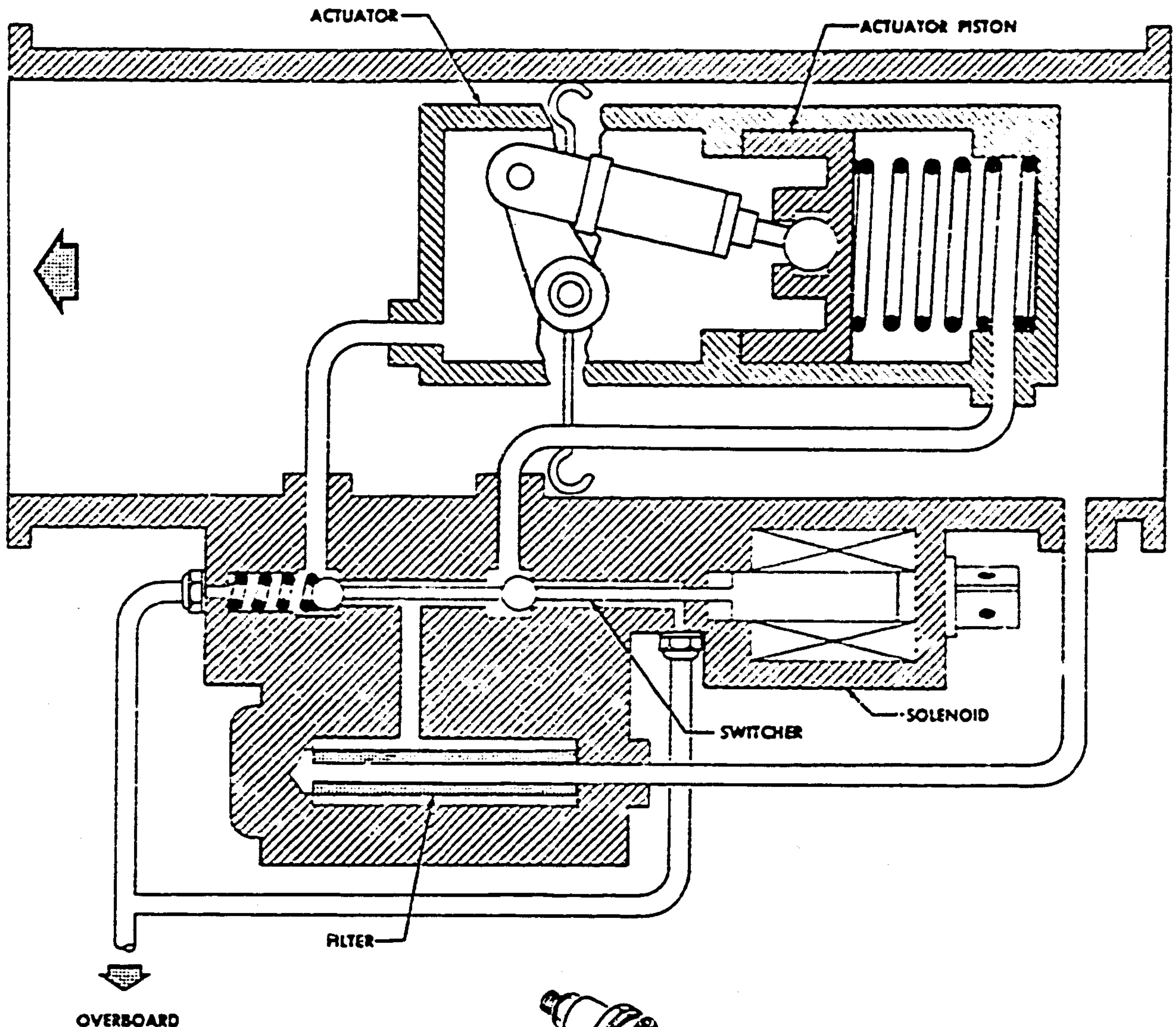
(1) The tail duct valve controls the air supply to the deicing and anti-icing ducts and components of the horizontal stabilizers. The valve is open only when the airfoil deicing system is operating. It is located in the forward end of the tail duct at the juncture of the wing and fuselage sections of the airplane pneumatic manifold (left side).

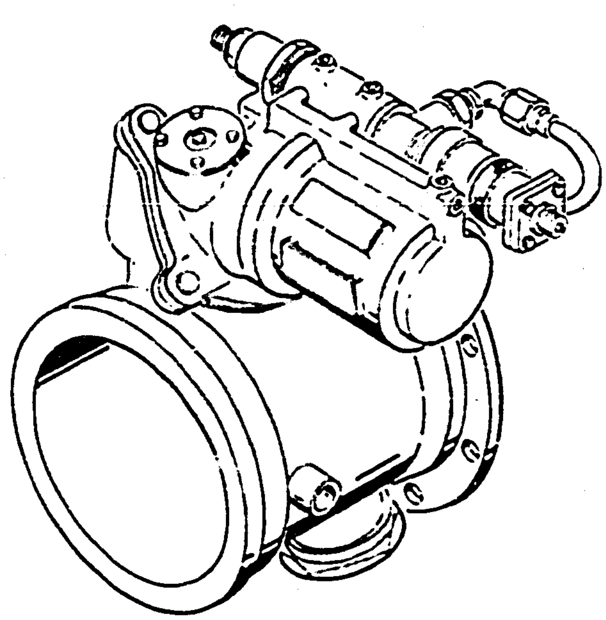
(2) The valve is an electrically controlled, pneumatically actuated butterfly valve, requiring both electrical and pneumatic power to open. The valve closes any time electrical power is removed from the solenoid, even in the absence of pneumatic power.

C. Airfoil Deicing Valve (See Figures 4 and 5.)

(1) Airfoil deicing valves are used in the deicing system to cycle air from the pneumatic ducts to the D-ducts that are located in the leading edge of the wings. The D-ducts are divided into sections and each section is supplied with air from the pneumatic duct system through a deicing valve. The valves are attached to the supply duct with V-band clamps and are connected to their respective D-duct section with a flexible connector and a band-type clamp. A total of 12 deicing valves are used in the system; six in each wing.

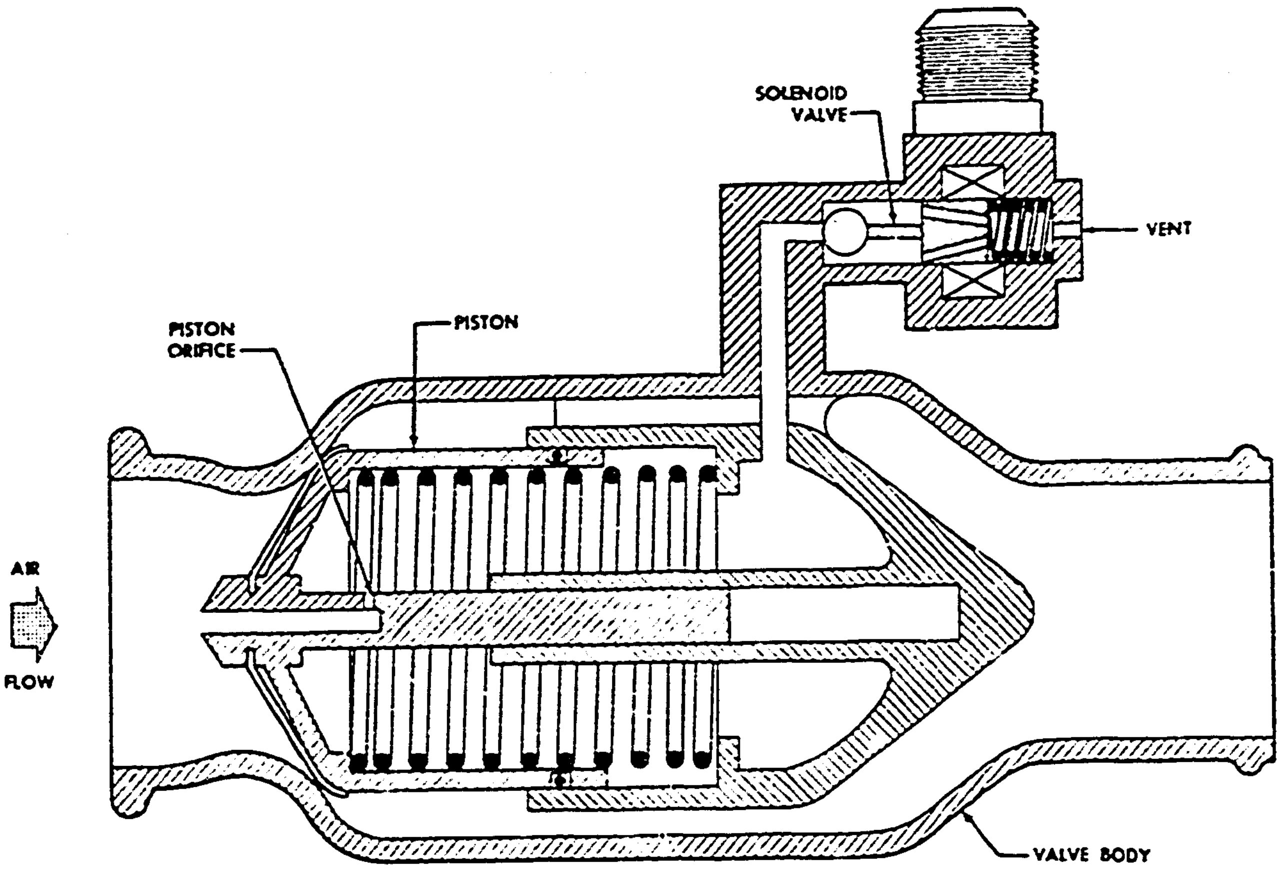
(2) In each wing, one valve is located between the fuselage and the inboard pylon to deice the wing slot area (inner-wing valve), two valves are located between the pylons (center-wing valves), and three valves are located outboard of the outboard pylons (outer-wing valves). All deicing valves are electrically controlled and pneumatically actuated. Air from the low-pressure pneumatic system is always available to the center-wing and inner-wing valves when the pneumatic manifold is pressurized. Air from the pneumatic system is available to the outer-wing valves and to the stabilizer valves when, during operation of the deicing or anti-icing system, the tail duct valve and the outer wing pneumatic duct shutoff valves are open. The valves return to the normally-closed position when electrical power is removed from the solenoid.

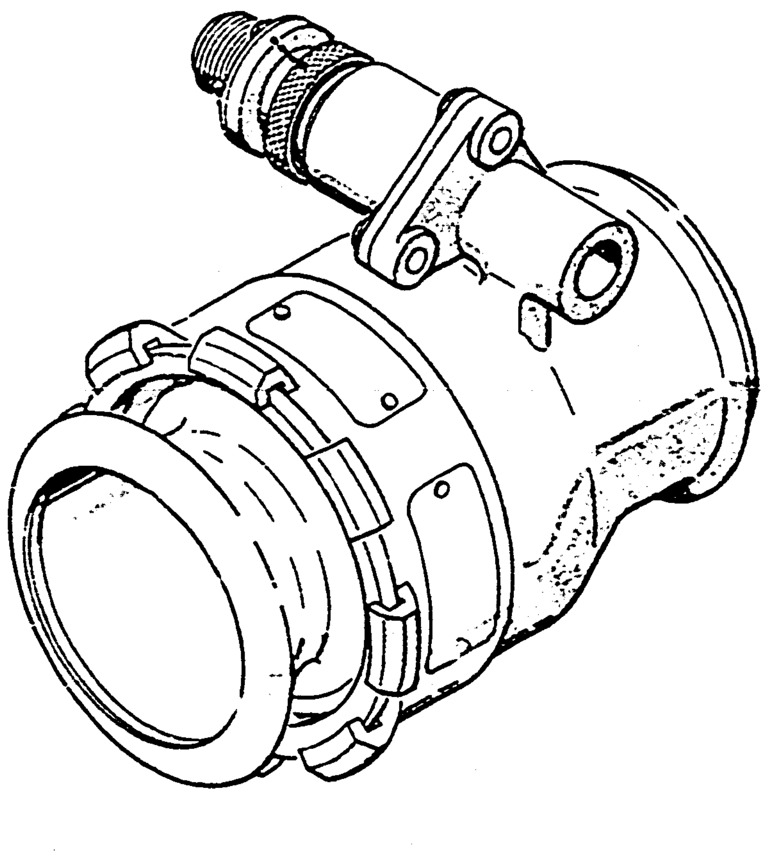




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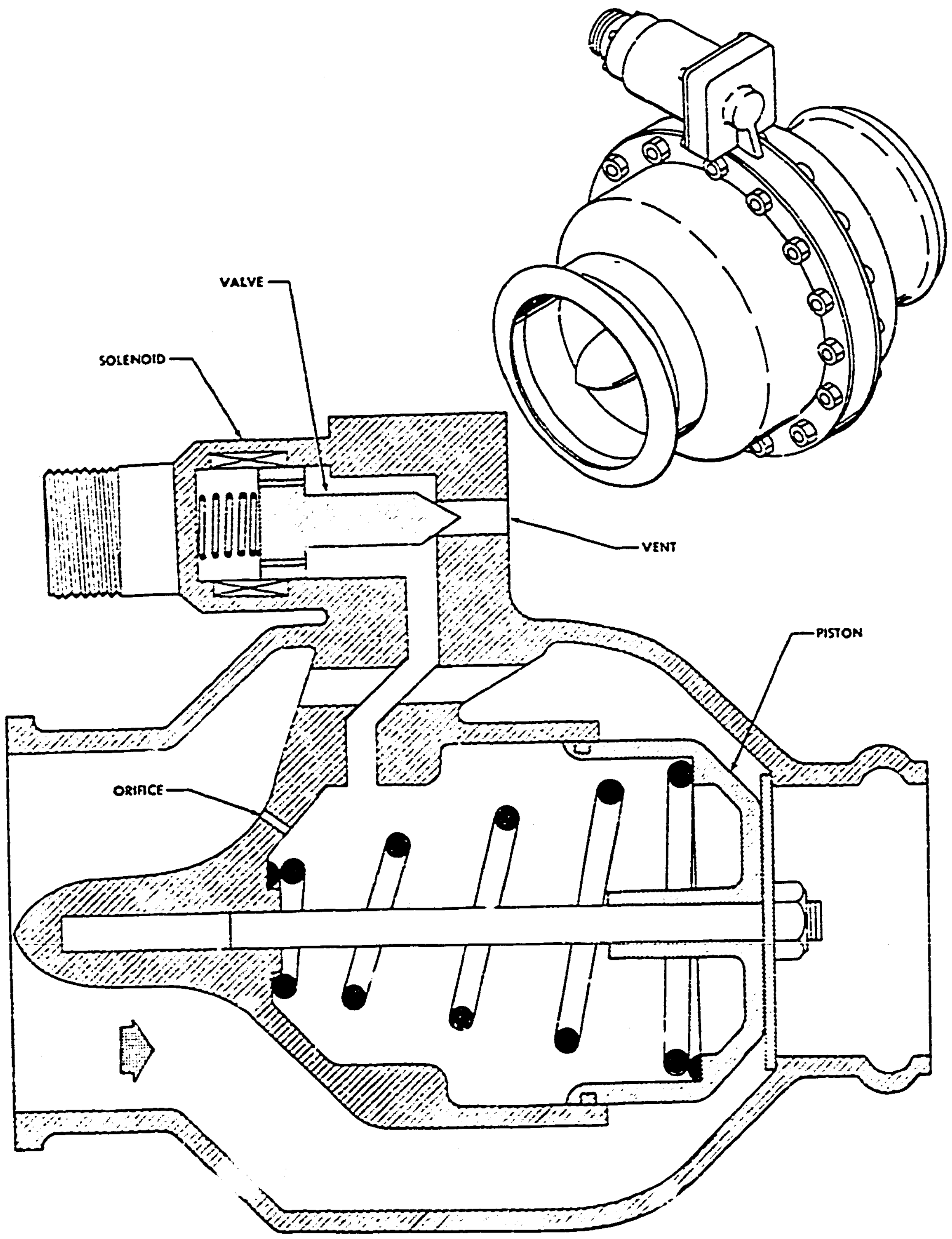
Tail Duct Valve -- Schematic
Figure 3





HA2-1578

Outer Wing Deicing Valve -- Schematic
Figure 4



Inner Wing Deicing Valve -- Schematic
Figure 5

D. Airfoil Deicing Timers (See Figure 6.)

(1) The airfoil deicing timers control the on-off cycling of the airfoil deicing valves. Two timers are mounted on the systems engineer's control panel. One timer acts as the standby while the other one is connected in the circuit through the airfoil deicing switch.

(2) The timers have an airfoil deicing timer cycle selector knob and an airfoil deicing timer temperature selector knob. The dial is graduated from 0° to -30°C for ram-air temperature selections. The switch-actuating camshaft in the timer is driven faster or slower by a variable speed drive that is controlled by the temperature selector knob. When the deicer timer selector knob is placed in the test position, the timer will go through the complete cycle in 23 to 31 seconds. The manually-set cycle selector knob determines cycle time according to the ram-air temperature indication. The cycle time can be doubled by pulling out and turning the cycle selector knob from the normal cycle to the long cycle position.

(3) A portion of a dial is seen through a window in the face of the timer. The number of the airfoil deicing valve that should be open at any given time appears in the window of the timer.

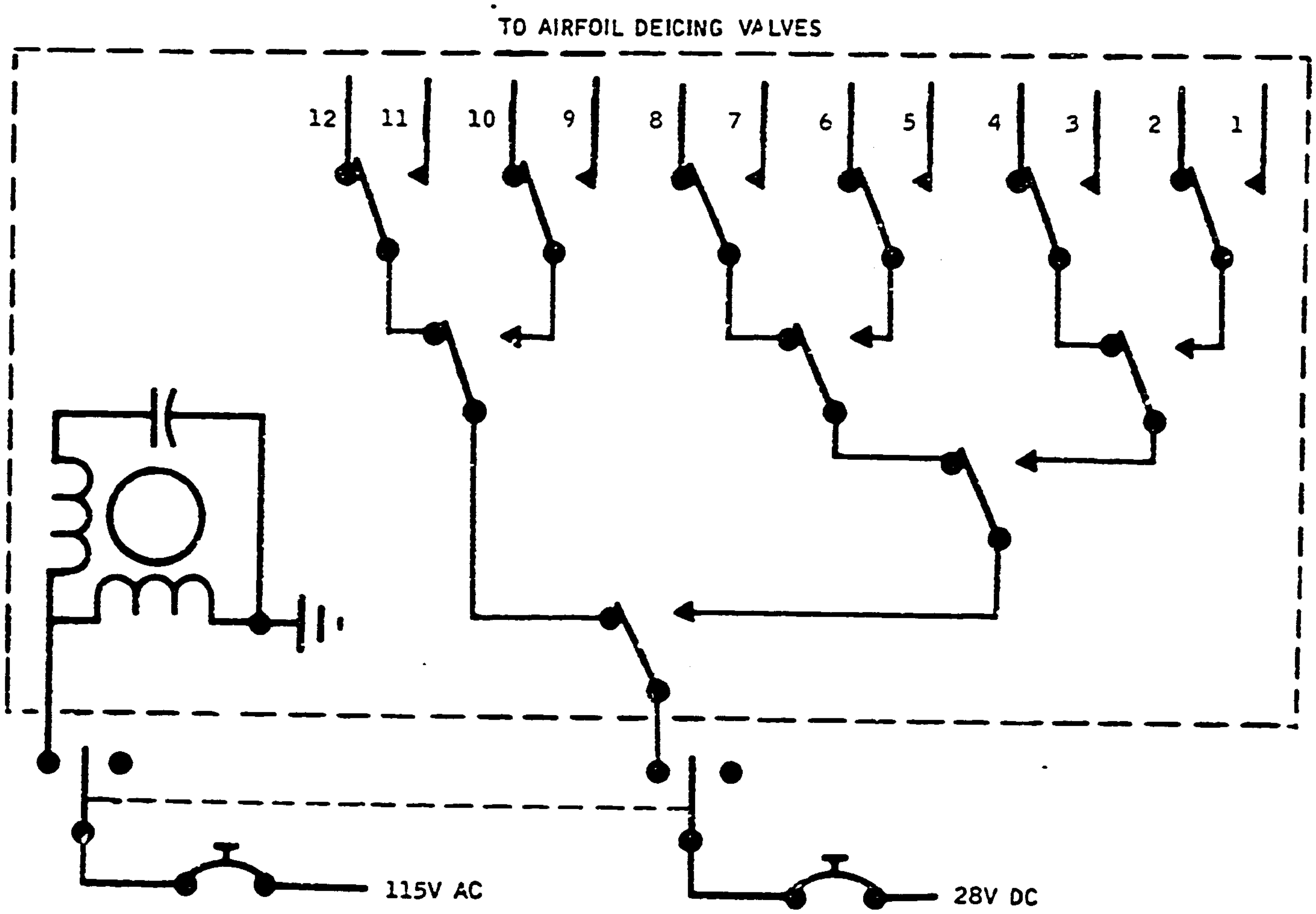
E. Tail Duct Venturi Differential-Pressure Switch (See Figure 7.)

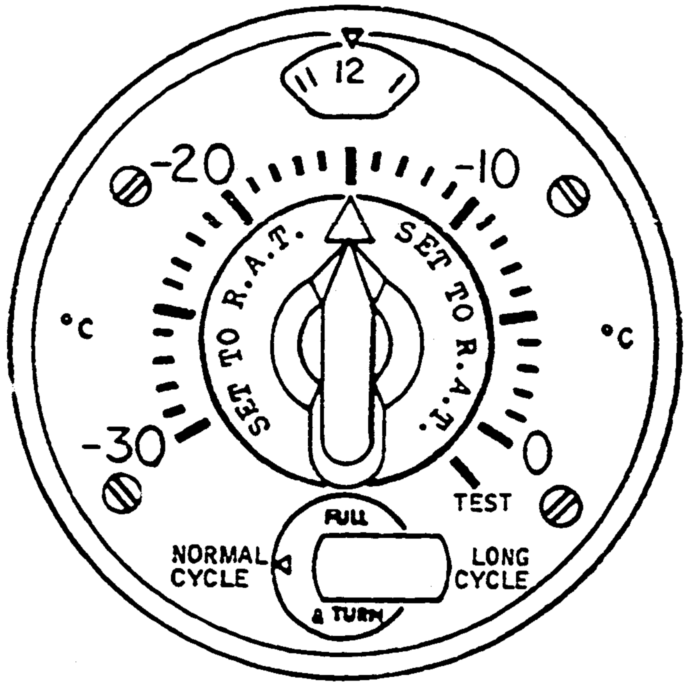
(1) The tail duct venturi differential-pressure switch is installed in the airfoil deicing system to operate an amber indicating light in the flight compartment. The differential-pressure switch, connected to the venturi downstream of the tail duct valve, senses any malfunction in the tail section that causes low airflow, and completes an electrical circuit to operate the indicating light. Differential-pressure across the tail duct venturi actuates a diaphragm to which the load contacts are connected.

3. Operation

A. The airfoil deicing system is set in operation by placing the following controls in the noted position:

Control	Position
Tail duct valve switch	normal
Airfoil deicing timer cycle selector knob	normal cycle
Airfoil deicing timer temperature selector knob	at ram-air temperature
Airfoil deicing switch	timer 1 or timer 2.





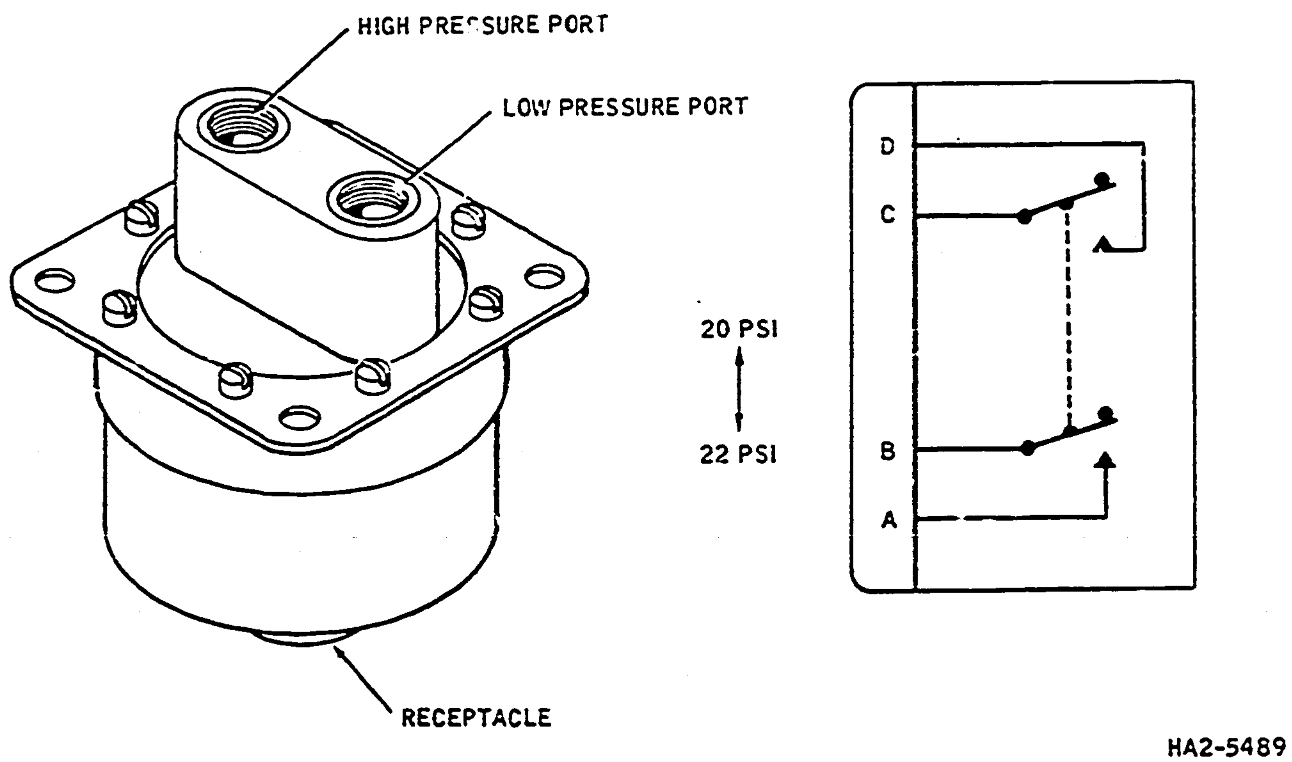
HA2-2072

Airfoil Deicing Timer -- Functional
Figure 6

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NOTE: The deicing valves are deactivated on the ground through the operation of the left air-conditioning ground control relay. This feature is incorporated in the system to avoid overheating the structure. For ground operation, see Maintenance Practices, this section.

B. When the airfoil deicing switch is placed in timer 1 or timer 2 position, air from the supply ducts and the manifold is directed to the airfoil leading edges and wing leading edge slots through the deicing valves. These valves are electrically controlled by the selected timer to supply air to one or more sections of the D-duct in the leading edge of each airfoil. Through the action of the timer, air is supplied intermittently and in sequence to corresponding sections of the D-duct. This action electrically controls the opening and closing rate of the deicing valves. One deicing cycle is completed when all wing leading edge areas have received deicing air. This cycle is repeated until the airfoil deicing switch is placed in the off position.



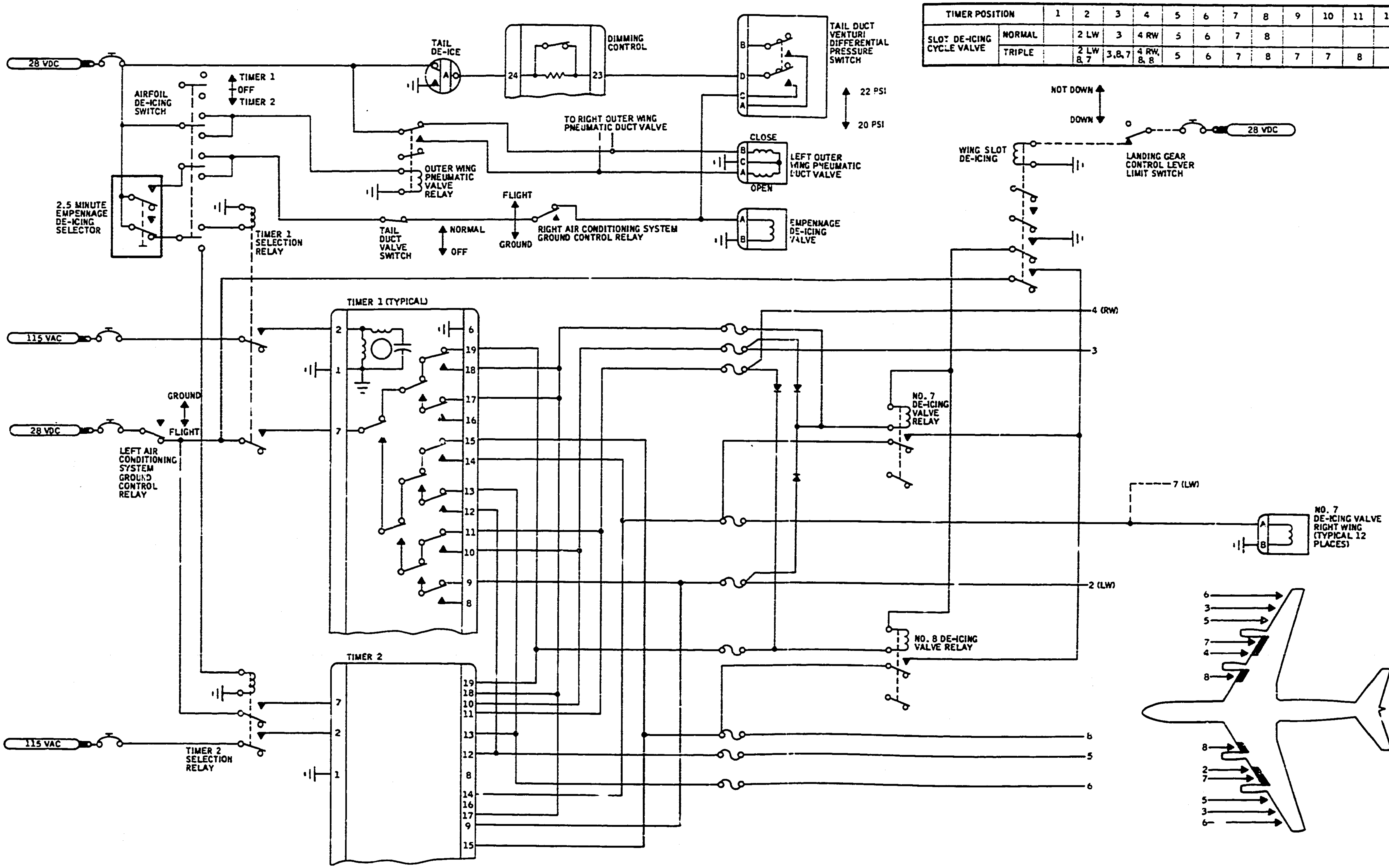
Tail Duct Venturi Differential Pressure -- Switch
Figure 7

C. When the airfoil deicing switch is placed in timer 1 or timer 2 position, and the tail deice pushbutton is energized the tail deicing valve will open and begin a 150-second cycle at which time high pressure hot air will flow to the tail deicing ports, deicing the tail. If during any cycle the tail deice pushbutton is reenergized a second 150-second cycle will begin.

D. To prevent the formation of runback ice, and to shed secondary ice, an airfoil deicing timer cycle selector knob, is provided at the bottom of the timer dial for selecting a normal cycle or a long cycle. When the knob is positioned from normal cycle to long cycle prior to turning off the deicing system, the length of time that the deicing valves remain open is doubled. A small portion of a rotating dial is visible in a window at the top of the timer. The identifying number of the airfoil deicing valves that should be open at any given time appears in the window of the timer, with the exception of positions 11 and 12. These positions have no corresponding valves since the vertical stabilizer is not deiced. The letter adjacent to the number indicates the general location of the valves; for example, L for left wing, R for right wing, and T for tail.

E. During approach and landing operations, it is necessary that the wing slot areas be deiced more frequently than the unslotted areas. When the landing gear control lever is placed in the down position, the slotted area deicing valves open for three extra intervals during the same time that all the valves are operating in their regular sequence. With the landing gear control lever in this position, the fuselage nose anti-icing valves are locked closed to conserve engine bleed air.

TIMER POSITION		1	2	3	4	5	6	7	8	9	10	11	12
SLOT DE-ICING CYCLE VALVE	NORMAL		2 LW	3	4 RW	5	6	7	8				
	TRIPLE		2 LW 8, 7	3,8,7	4 RW, 8, 8	5	6	7	8	7	7	8	



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Airfoil Deicing System -- Electrical Schematic
Figure 8

AIRFOIL - DESCRIPTION AND OPERATION

1. General

A. The airfoil deicing system removes ice from the leading edges of the wing, the leading edges of the wing slots, the wing slots lower doors, and the leading edges of the horizontal stabilizer. Hot air from the low-pressure pneumatic system is distributed to the leading edges through a system of ducts and by electrically controlled, pneumatically operated valves.

B. Fourteen deicing valves, 12 of which are operated in pairs by either one of two timers, permit intermittent airflow to the deicing segments.

C. An interlock wing slot deice relay is actuated when the landing gear control lever is placed in the down position. This permits a triple-cycle feature to deice the slotted wing sections approximately three times as often as the wing sections without slots.

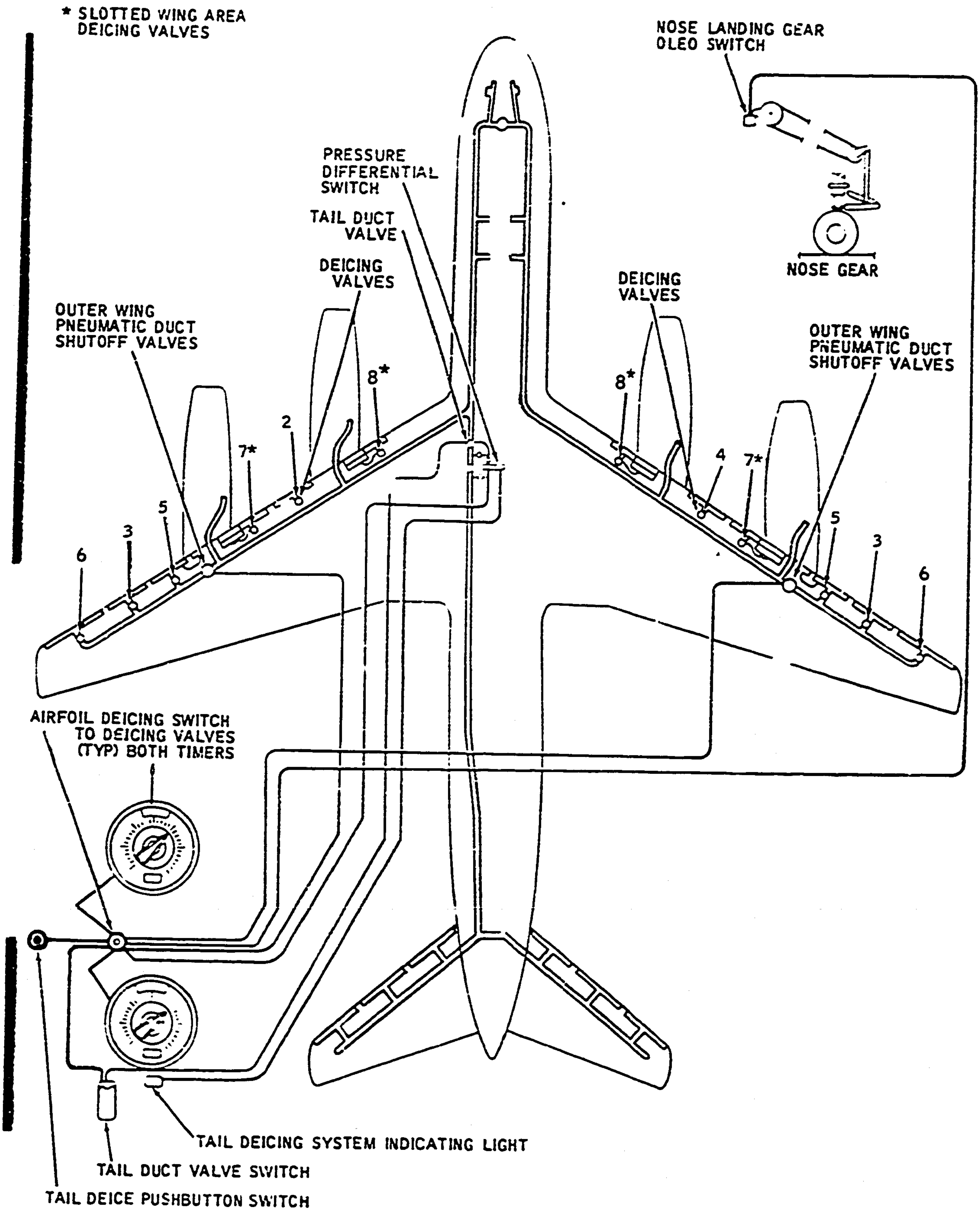
D. The following controls for the system are located on the engine instrument panel. They include the airfoil deicing switch, a guarded tail duct valve switch, tail deice pushbutton, and a tail deicing system indicating light. The two identical airfoil deicing timers are located on the systems engineers control panel. The system is electrically interlocked with the ground control relay circuit so that the deicing valves cannot be operated on the ground.

E. The deicing timer motors, the tail duct valve, and the outer wing pneumatic duct shutoff valves are independent of the ground control relay.

F. Air directed to the center and inner wing leading edges (inboard of No. 1 and 4 pylons) is supplied directly by the pneumatic manifold. From the low-pressure pneumatic manifold, air is directed to the left and right outer wings (outboard of No. 1 and 4 pylons) through the outer wing pneumatic duct shutoff valves, and to the empennage through the tail duct valve and the tail duct. The tail duct extends from the tail duct valve in the fuselage to the tail section of the airplane. This duct is located on the left side of the fuselage below the floor, in the pressurized area, and extends into the horizontal stabilizer. D-ducts in the leading edge of each airfoil are divided into a total of 18 sections and direct the distribution of air through the leading edge areas to be deiced. All D-ducts are riveted to ribs located in the wing and stabilizer leading edges, and are removed and installed as integral components of the leading edge structure (see Chapters 55 and 57). The deicing air exhausts overboard from the wing leading edges through slots in the lower surface between pylons. Air from the horizontal stabilizer leading edges exhausts into the tail cone and overboard through slots in the tail cone, the elevator torque tube, and the horizontal stabilizer torque box.

G. V-band clamps and flexible connectors connect the tail duct sections. The flexible connectors in the pressurized area are a double-walled type, similar to the connectors used in the pneumatic manifold (see Chapter 36)

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Airfoil Deicing System -- Schematic
Figure 1

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with the exception of the attaching flanges. The connectors in the non-pressurized area (tail section) are a single-walled type attached to the beaded ends of the duct with clamps.

H. The tail duct directs air to the horizontal stabilizer. A Y-duct in the horizontal stabilizer with a flexible connector located at the pivot of the stabilizer allows the duct to flex with stabilizer movement. The ducts in the stabilizer leading edge have three deicing ports on each side of the stabilizer. A bleed orifice is located near the outboard end of the ducts. Air from the tail duct bleeds into the leading edge area from these orifices, ensuring a hot air supply to all tail deicing flow-limiting orifices when the tail duct valve is open.

I. A flow-limiting venturi, located just downstream of the tail duct valve, provides a pressure signal for the tail duct valve differential-pressure switch. Two sensing lines are connected across the venturi, one at the throat and one immediately upstream of the venturi.

J. The outer wing ducts extend from the outer wing pneumatic duct shutoff valves, connected to the pneumatic manifold (outboard of No. 1 and 4 pylons), to the wing tips. An anti-icing air outlet is located near the outboard end of each duct. The two ducts are composed of sections connected with clamps and single-wall flexible connectors. Each section is supported by a fixed and slip-type bracket. The fixed bracket holds the duct section rigid where the deicing valves attach to the deicing air outlets. The slip supports allow the duct to expand and contract, and also allow for structural deflections.

K. The airfoil deicing controls and indicating light system provides for electrical control and monitoring of the deicing of the wing and tail surfaces. The system controls and indicating light are located on the engine instrument panel and include the following:

(1) Airfoil deicing switch, with timer 1--off--timer 2 positions

(2) Tail deicing pushbutton (to cycle tail duct valve for 150 seconds)

(3) Tail deicing system indicating light

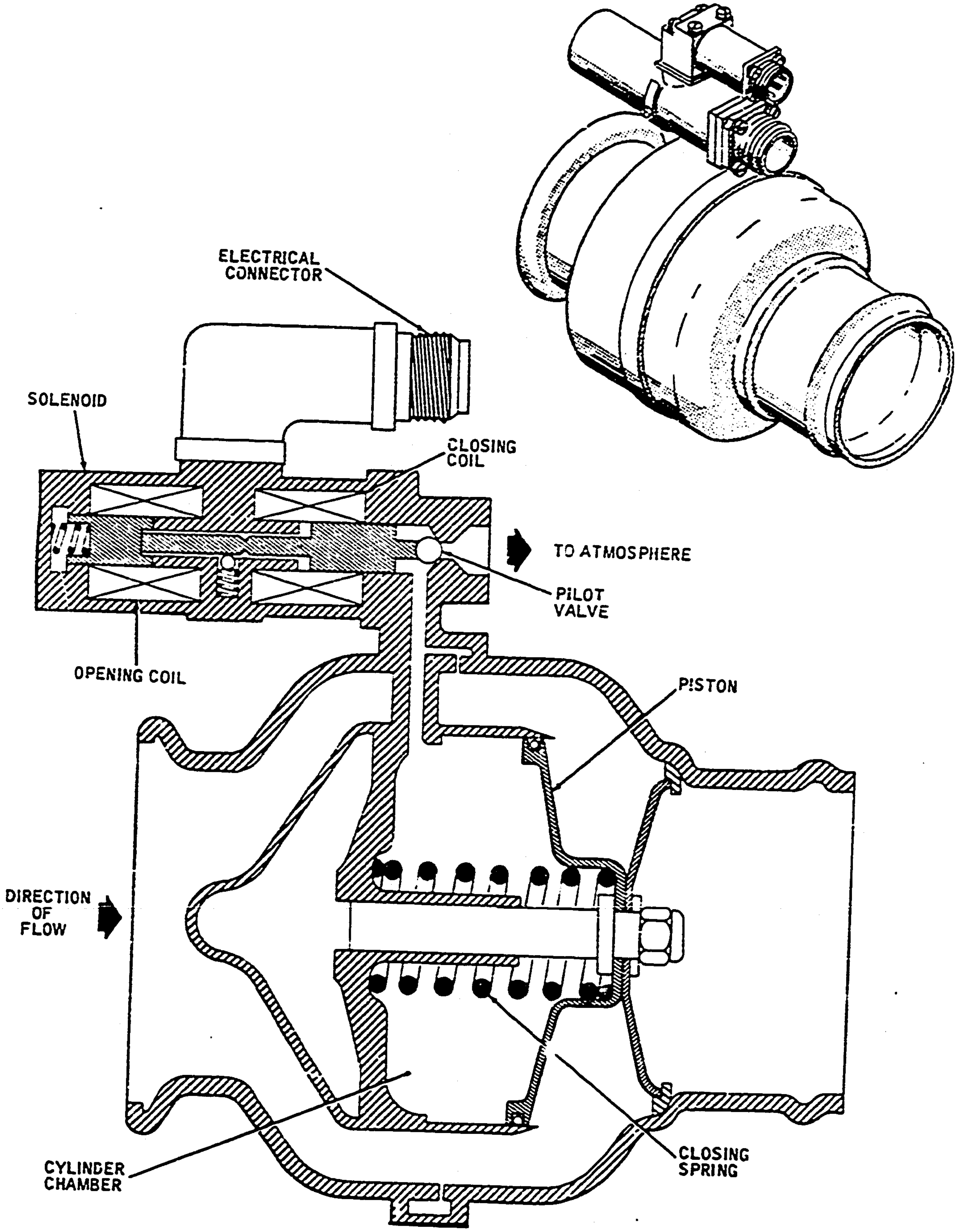
(4) Tail duct valve switch, with normal--off positions.

L. The two airfoil deicing timers (these also act as cycle sequence indicators for wing deicing valves) are located on the systems engineer's control panel.

2. Component Description

A. Outer Wing Pneumatic Duct Shutoff Valve (See Figure 2.)

(1) An outer wing pneumatic duct shutoff valve is installed between the low-pressure pneumatic manifold and the outer wing pneumatic duct.



Outer Wind Pneumatic Duct Shutoff Valve -- Schematic
Figure 2

(2) It is an electrically controlled, pneumatically actuated, poppet-type valve. The valve operates when the pneumatic manifold is pressurized and electrical power is directed to the valve by either the airfoil deicing system or the anti-icing system.

(3) When electrical power is supplied to the open winding of the valve solenoid by one of the above systems, air pressure from the pneumatic system opens the valve. As long as pneumatic power is supplied, the valve remains open until the close winding of the valve solenoid is energized. When the valve opens, air from the pneumatic system is directed to the outer wing pneumatic duct. The duct supplies air to the outer wing deicing valves and to the outer wing vent scoop.

B. Tail Duct Valve (See Figure 3.)

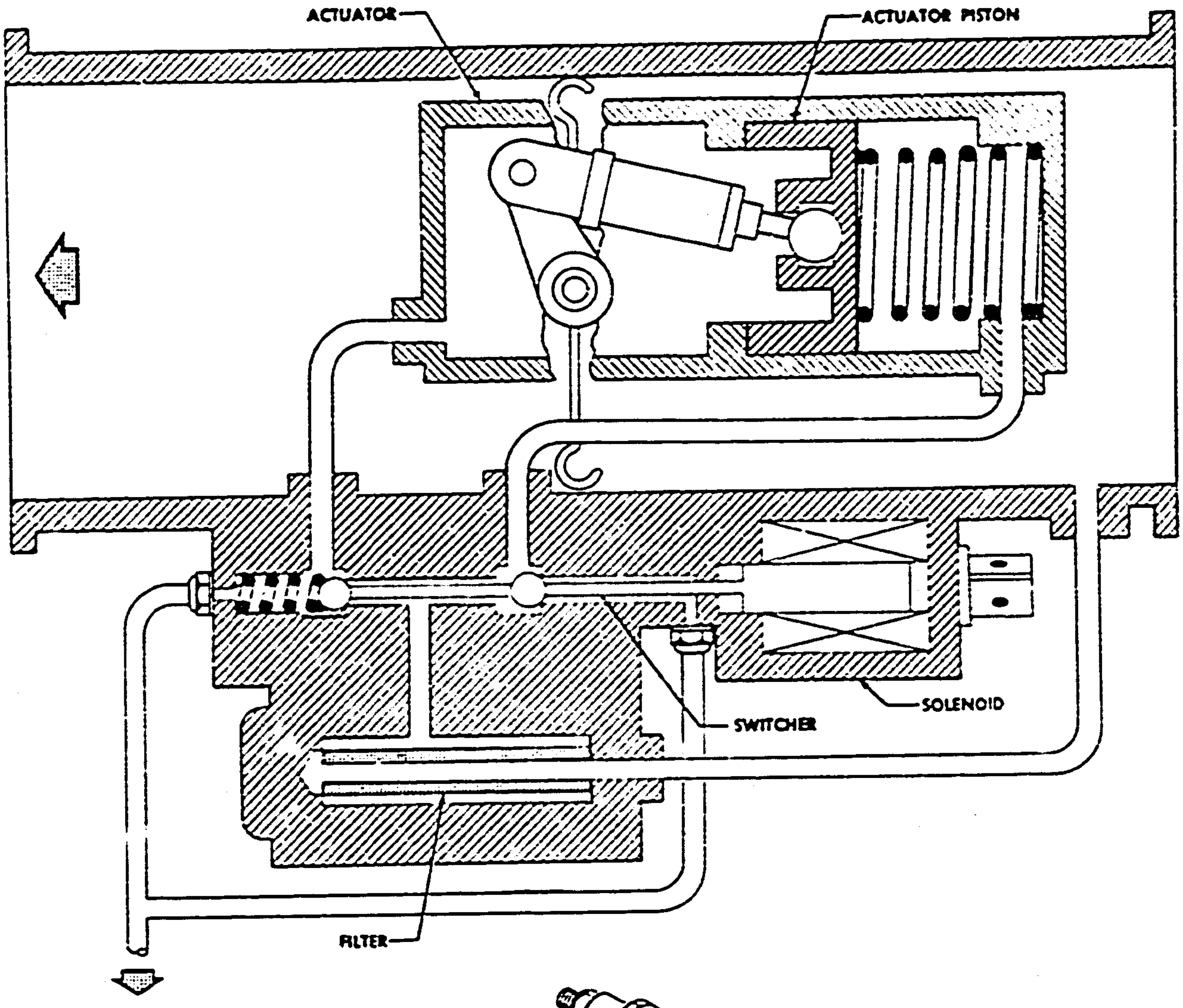
(1) The tail duct valve controls the air supply to the deicing and anti-icing ducts and components of the horizontal stabilizers. The valve is open only when the airfoil deicing system is operating. It is located in the forward end of the tail duct at the juncture of the wing and fuselage sections of the airplane pneumatic manifold (left side).

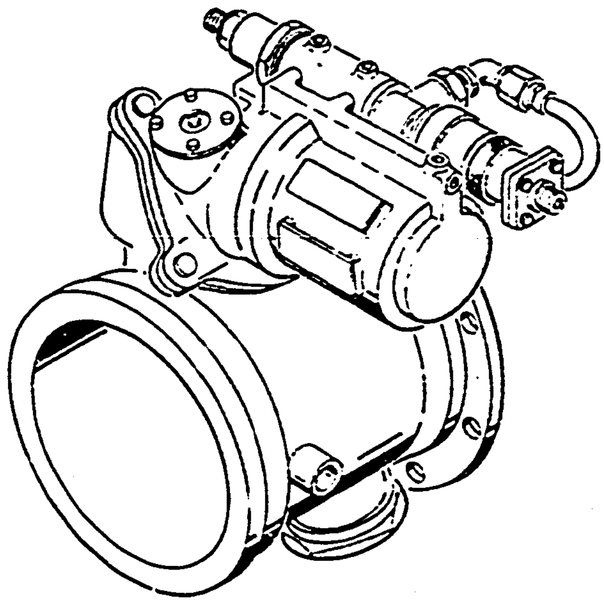
(2) The valve is an electrically controlled, pneumatically actuated butterfly valve, requiring both electrical and pneumatic power to open. The valve closes any time electrical power is removed from the solenoid, even in the absence of pneumatic power.

C. Airfoil Deicing Valve (see Figures 4 and 5.)

(1) Airfoil deicing valves are used in the deicing system to cycle air from the pneumatic ducts to the D-ducts that are located in the leading edge of the wings. The D-ducts are divided into sections and each section is supplied with air from the pneumatic duct system through a deicing valve. The valves are attached to the supply duct with V-band clamps and are connected to their respective D-duct section with a flexible connector and a band-type clamp. A total of 12 deicing valves are used in the system; six in each wing.

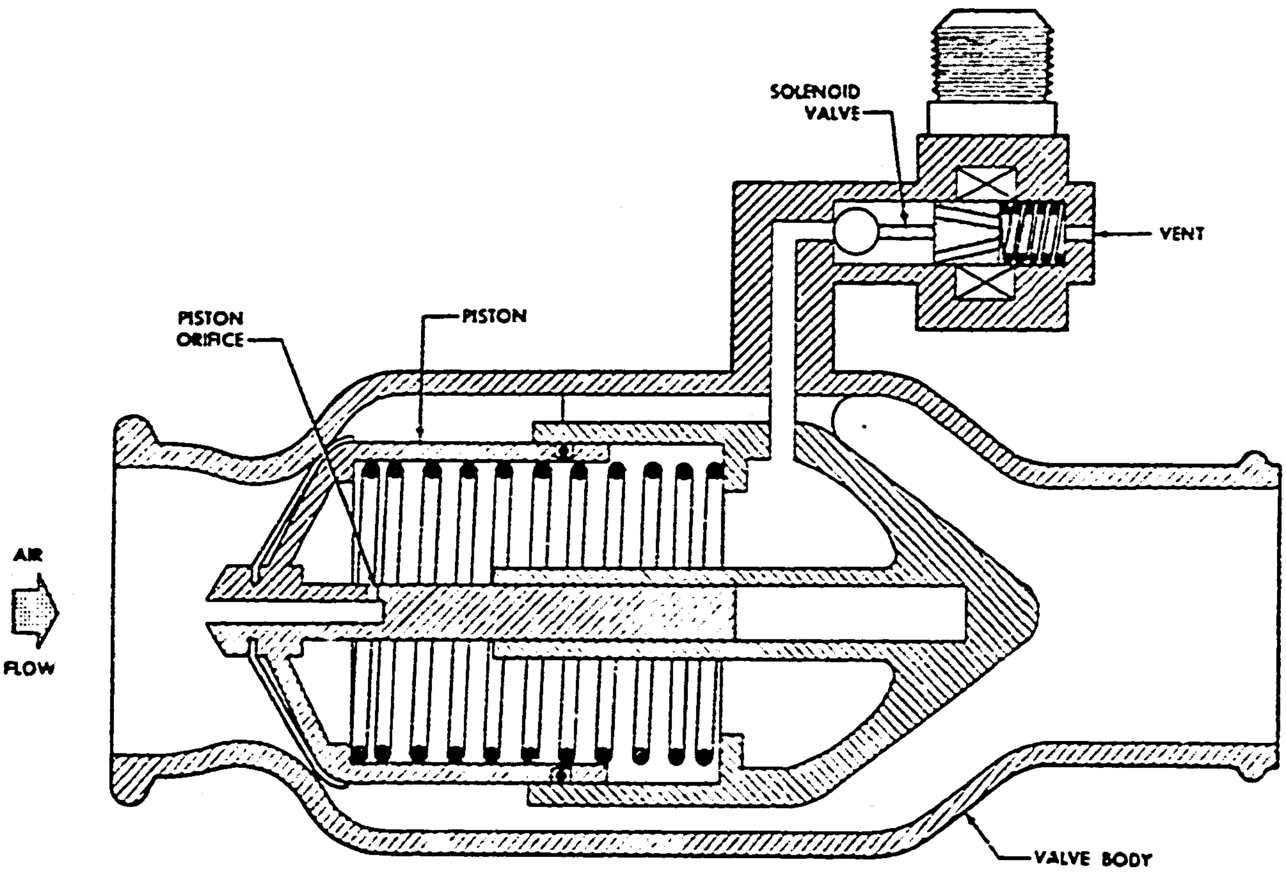
(2) In each wing, one valve is located between the fuselage and the inboard pylon to deice the wing slot area (inner-wing valve), two valves are located between the pylons (center-wing valves), and three valves are located outboard of the outboard pylons (outer-wing valves). All deicing valves are electrically controlled and pneumatically actuated. Air from the low-pressure pneumatic system is always available to the center-wing and inner-wing valves when the pneumatic manifold is pressurized. Air from the pneumatic system is available to the outer-wing valves and to the stabilizer valves when, during operation of the deicing or anti-icing system, the tail duct valve and the outer wing pneumatic duct shutoff valves are open. The valves return to the normally-closed position when electrical power is removed from the solenoid.

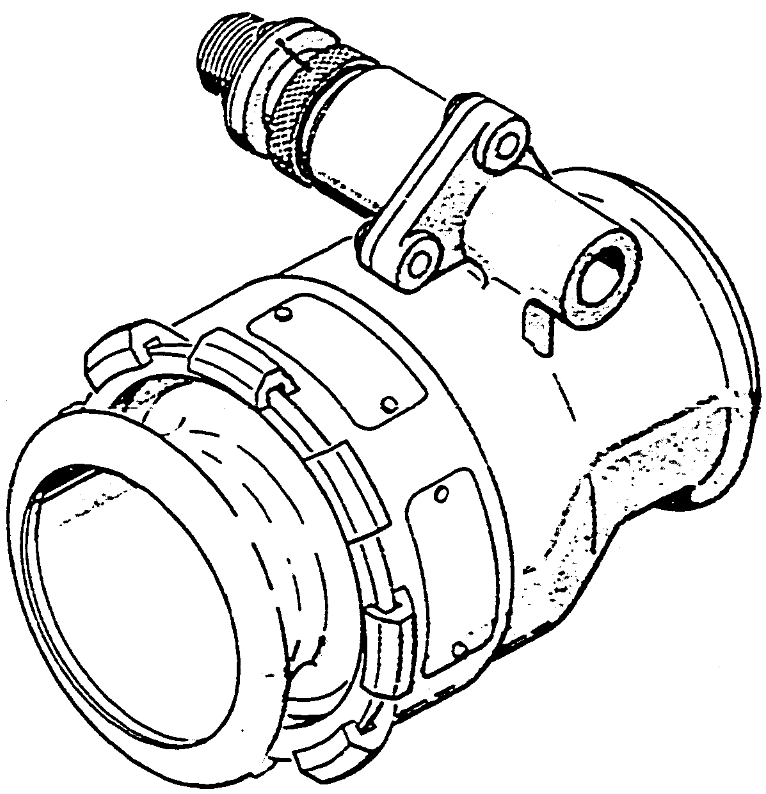




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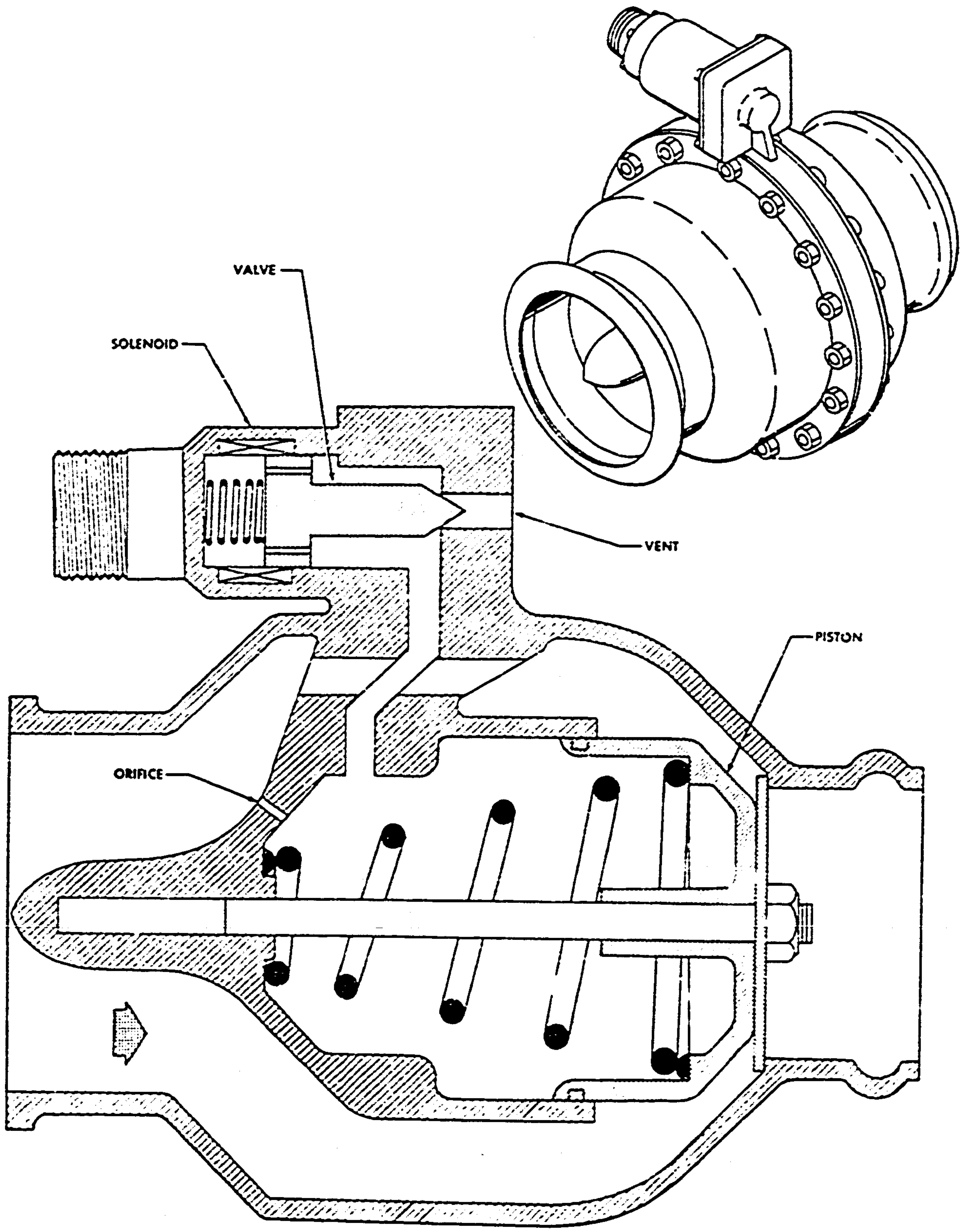
Tail Duct Valve -- Schematic
Figure 3





HA2-1578

Outer Wing Deicing Valve -- Schematic
Figure 4



HA2-1579

Inner Wing Deicing Valve -- Schematic
Figure 5

D. Airfoil Deicing Timers (See Figure 6.)

(1) The airfoil deicing timers control the on-off cycling of the airfoil deicing valves. Two timers are mounted on the systems engineer's control panel. One timer acts as the standby while the other one is connected in the circuit through the airfoil deicing switch.

(2) The timers have an airfoil deicing timer cycle selector knob and an airfoil deicing timer temperature selector knob. The dial is graduated from 0° to -30°C for ram-air temperature selections. The switch-actuating camshaft in the timer is driven faster or slower by a variable speed drive that is controlled by the temperature selector knob. When the deicer timer selector knob is placed in the test position, the timer will go through the complete cycle in 23 to 31 seconds. The manually-set cycle selector knob determines cycle time according to the ram-air temperature indication. The cycle time can be doubled by pulling out and turning the cycle selector knob from the normal cycle to the long cycle position.

(3) A portion of a dial is seen through a window in the face of the timer. The number of the airfoil deicing valve that should be open at any given time appears in the window of the timer.

E. Tail Duct Venturi Differential-Pressure Switch (See Figure 7.)

(1) The tail duct venturi differential-pressure switch is installed in the airfoil deicing system to operate an amber indicating light in the flight compartment. The differential-pressure switch, connected to the venturi downstream of the tail duct valve, senses any malfunction in the tail section that causes low airflow, and completes an electrical circuit to operate the indicating light. Differential-pressure across the tail duct venturi actuates a diaphragm to which the load contacts are connected.

3 Operation

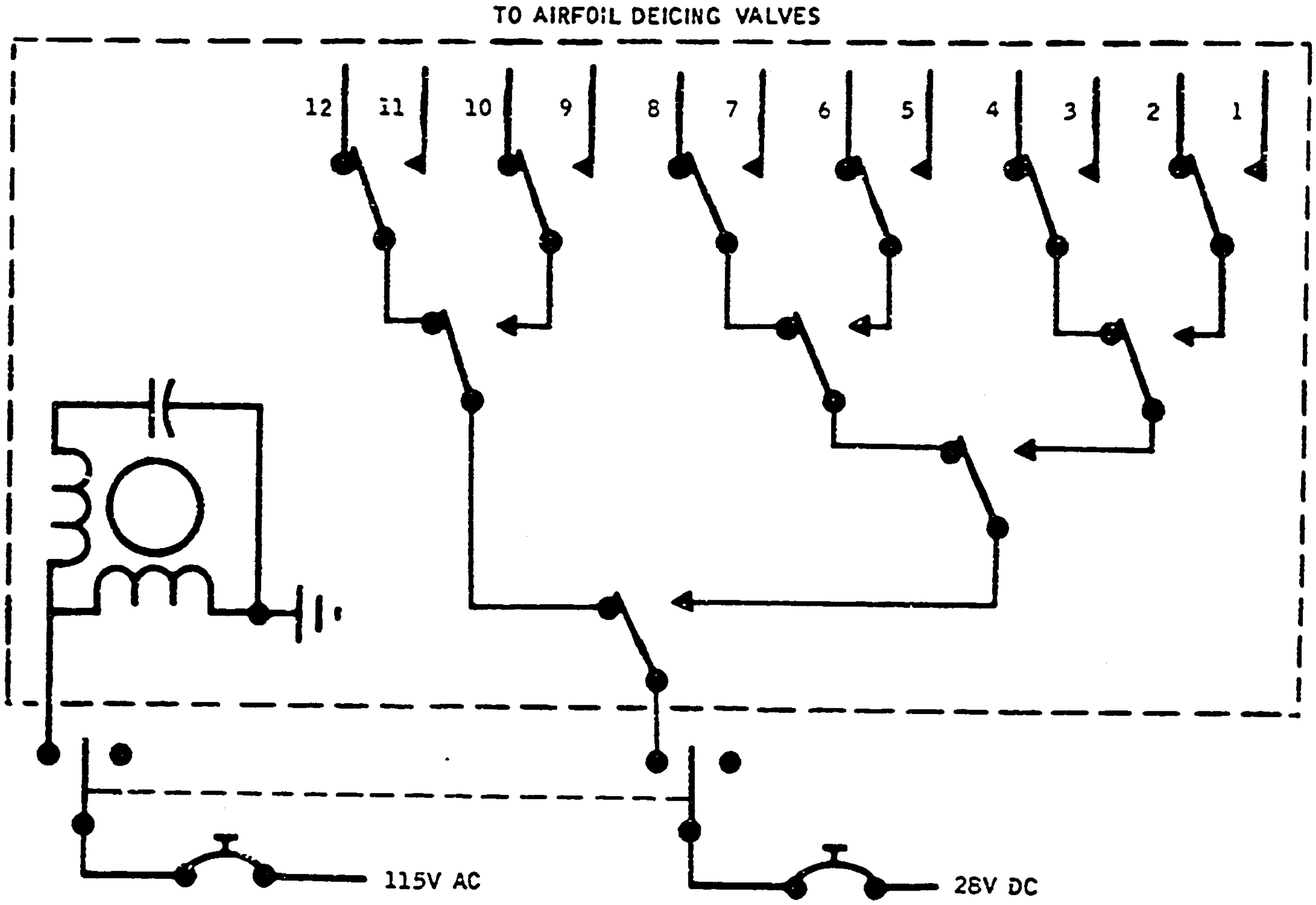
A. The airfoil deicing system is set in operation by placing the following controls in the noted position:

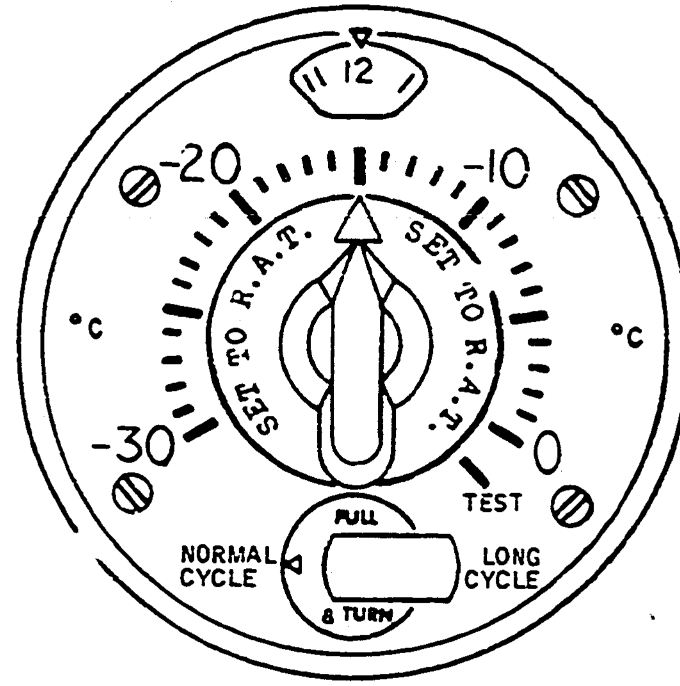
Tail duct valve switch . . . . normal

Airfoil deicing timer cycle
selector knob . . . . normal cycle

Airfoil deicing timer temperature
selector knob . . . . at ram-air temperature

Airfoil deicing switch . . . . timer 1 or timer 2





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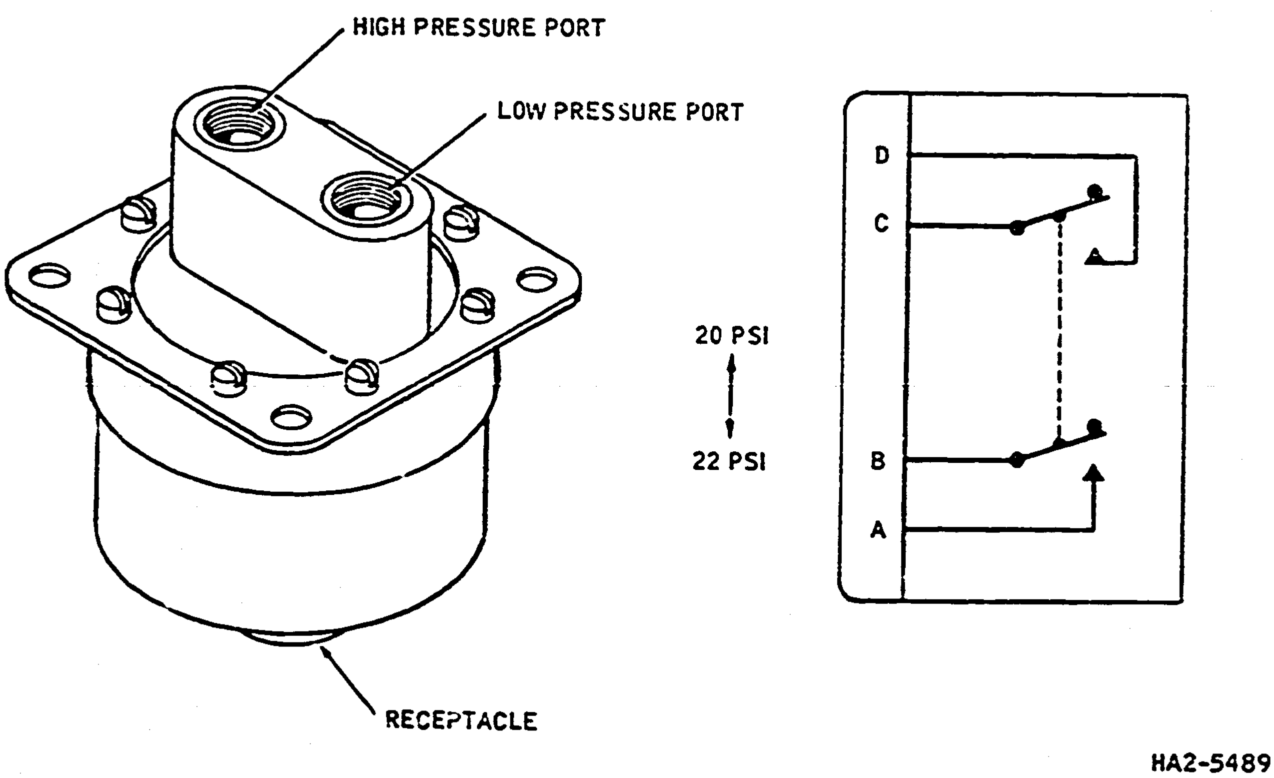
Airfoil Deicing Timer -- Functional
Figure 6

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NOTE: The deicing valves are deactivated on the ground through the operation of the left air-conditioning ground control relay. This feature is incorporated in the system to avoid overheating the structure. For ground operation, see Maintenance Practices, this section.

B. When the airfoil deicing switch is placed in timer 1 or timer 2 position, air from the supply ducts and the manifold is directed to the airfoil leading edges and wing leading edge slots through the deicing valves. These valves are electrically controlled by the selected timer to supply air to one or more sections of the D-duct in the leading edge of each airfoil. Through the action of the timer, air is supplied intermittently and in sequence to corresponding sections of the D-duct. This action electrically controls the opening and closing rate of the deicing valves. One deicing cycle is completed when all wing leading edge areas have received deicing air. This cycle is repeated until the airfoil deicing switch is placed in the off position.

C. When the airfoil deicing switch is placed in timer 1 or timer 2 position, and the tail deice pushbutton is energized the tail deicing valve will open and begin a 150-second cycle at which time high pressure hot air will flow to the tail deicing ports, deicing the tail. If during any cycle the tail deice pushbutton is reenergized a second 150-second cycle will begin.

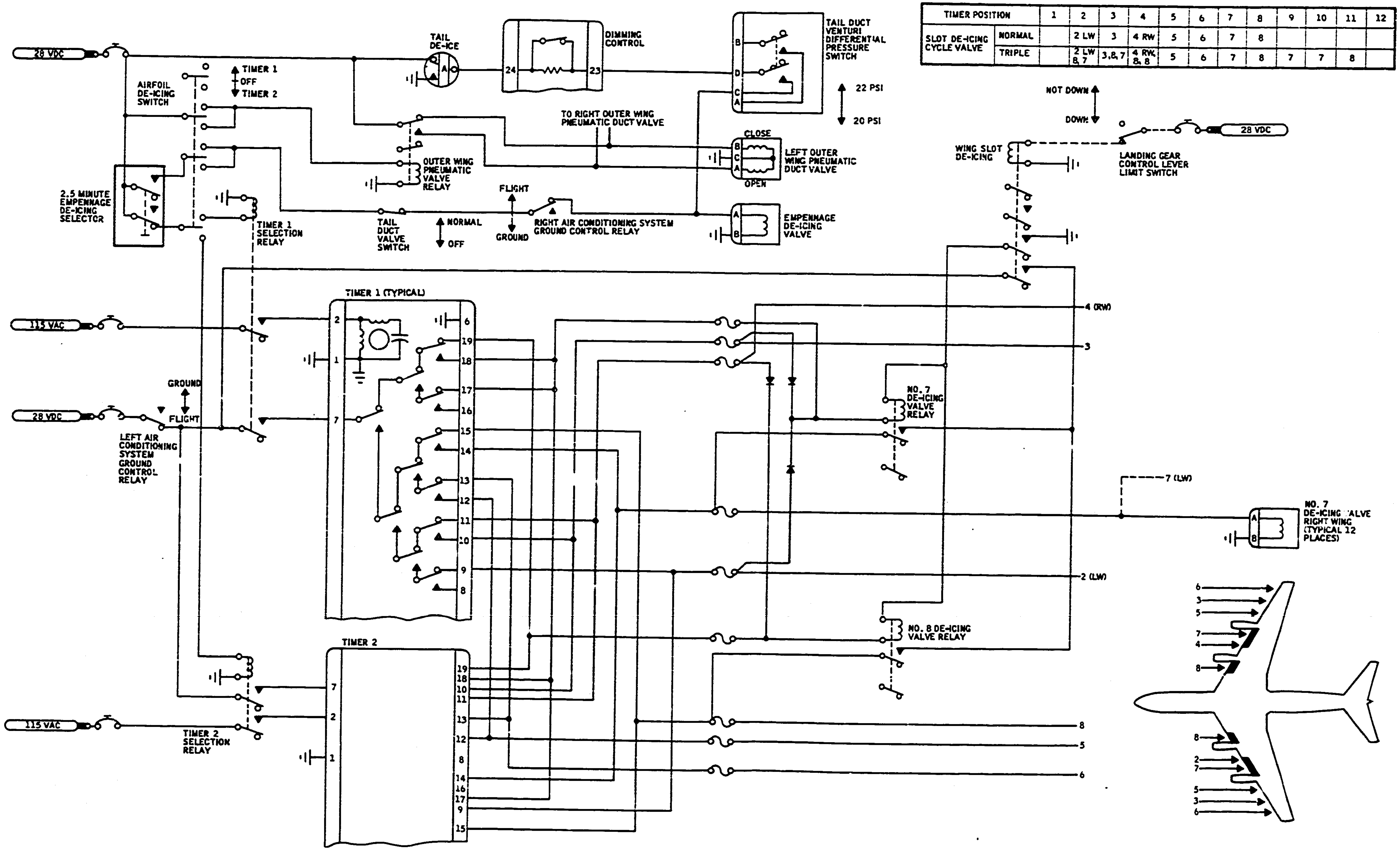


Tail Duct Venturi Differential Pressure -- Switch
Figure 7

D. To prevent the formation of runback ice, and to shed secondary ice, an airfoil deicing timer cycle selector knob, is provided at the bottom of the timer dial for selecting a normal cycle or a long cycle. When the knob is positioned from normal cycle to long cycle prior to turning off the deicing system, the length of time that the deicing valves remain open is doubled. A small portion of a rotating dial is visible in a window at the top of the timer. The identifying number of the airfoil deicing valves that should be open at any given time appears in the window of the timer, with the exception of positions 11 and 12. These positions have no corresponding valves since the vertical stabilizer is not deiced. The letter adjacent to the number indicates the general location of the valves; for example, L for left wing, R for right wing, and T for tail.

E. During approach and landing operations, it is necessary that the wing slot areas be deiced more frequently than the unslotted areas. When the landing gear control lever is placed in the down position, the slotted area deicing valves open for three extra intervals during the same time that all the valves are operating in their regular sequence. With the landing gear control lever in this position, the fuselage nose anti-icing valves are locked closed to conserve engine bleed air.

TIMER POSITION		1	2	3	4	5	6	7	8	9	10	11	12
SLOT DE-ICING CYCLE VALVE	NORMAL		2 LW	3	4 RW	5	6	7	8				
	TRIPLE		2 LW 8, 7	3, 8, 7	4 RW, 8, 8	5	6	7	8	7	7	8	



Airfoil Deicing System -- Electrical Schematic
Figure 8

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AIRFOIL - DESCRIPTION AND OPERATION

1. General (See Figures 1 through 3.)

   A. The airfoil deicing system removes ice from the leading edges of the wing, the leading edges of the wing slots, the wing slots lower doors, and the leading edges of the horizontal stabilizer. Hot air from the low-pressure pneumatic system is distributed to the leading edges through a system of ducts and by electrically controlled, pneumatically operated valves.

   B. The following deicing valves are operated in pairs by either one of two timers to permit intermittent airflow to the deicing segments:

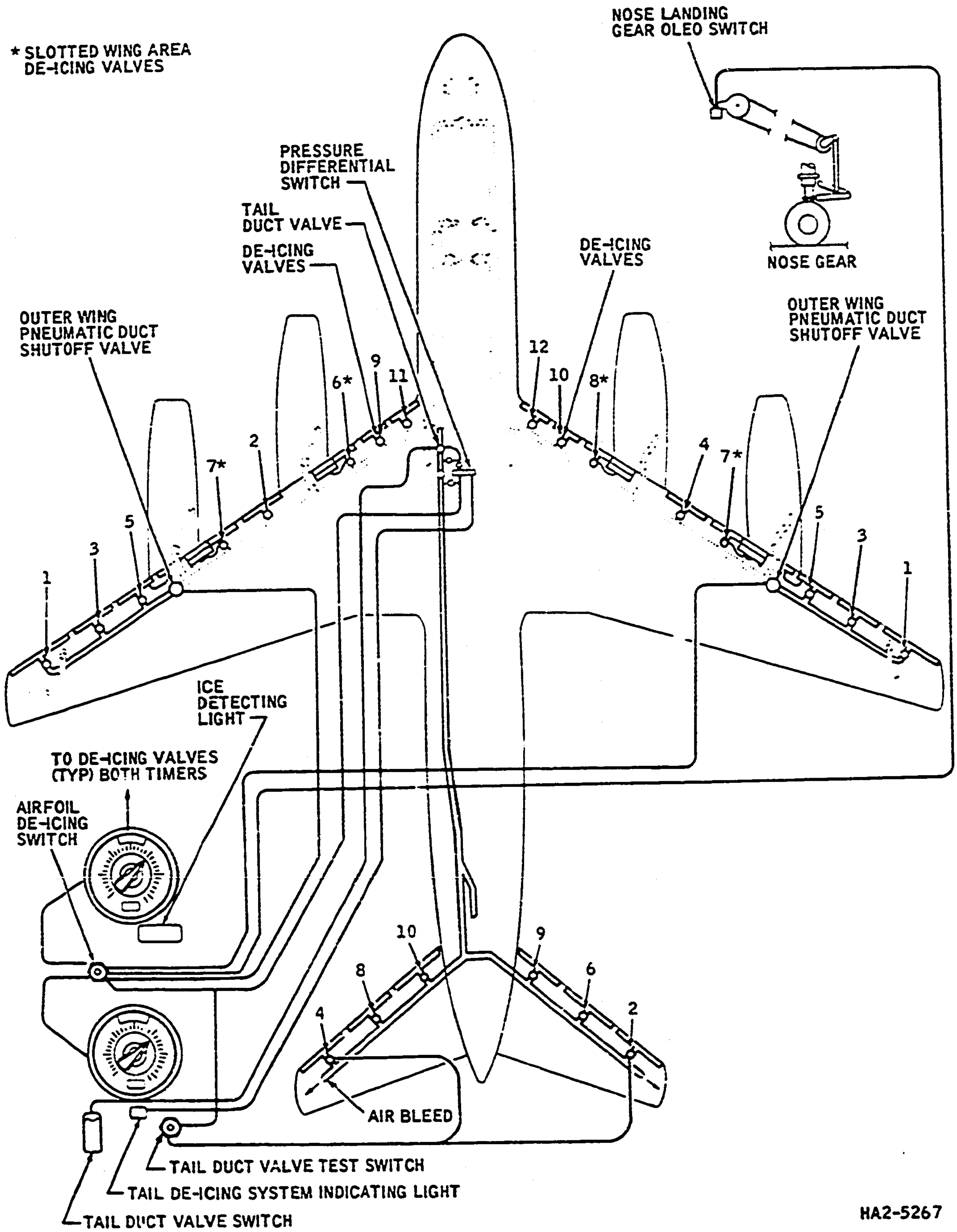
Valve	Location
Deicing valve (inner wing)	Three on each wing between fuselage and inboard pylon (airplanes 801-804). One on each wing (airplanes 805-819).
Deicing valve (center wing)	Two on each wing between pylons.
Deicing valve (outer wing)	Three on each wing outboard of outboard pylon.
Deicing valve (horizontal stabilizer)	Six in horizontal stabilizer leading edge.

   C. An interlock wing slot deice relay is actuated when the landing gear control lever is placed in the down position. This permits a triple-cycle feature to deice the slotted wing sections approximately three times as often as the wing sections without slots.

   D. Controls for the system are located on the main instrument panel. They include the airfoil deicing switch, two identical timers, a guarded tail duct valve switch, and a tail deicing system indicating light. The system is electrically interlocked with the ground control relay circuit so that the deicing valves cannot be operated on the ground. A tail duct valve test switch is also included on airplanes 801-817.

   E. The deicing timer motors, the tail duct valve, and the outer wing pneumatic duct shutoff valves are independent of the ground control relay.

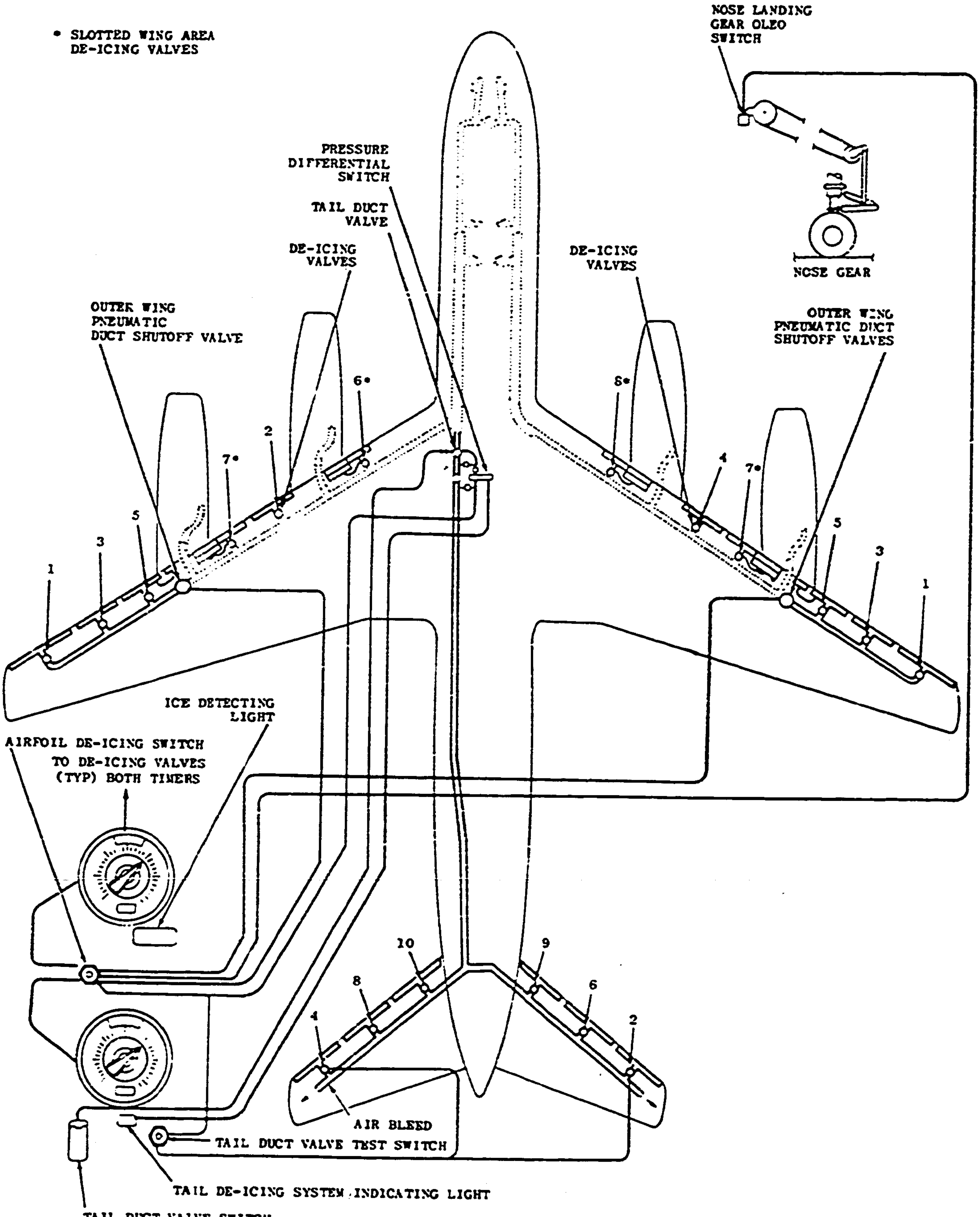
   F. Air directed to the center and inner wing leading edges (inboard of No. 1 and 4 pylons) is supplied directly by the pneumatic manifold. From the



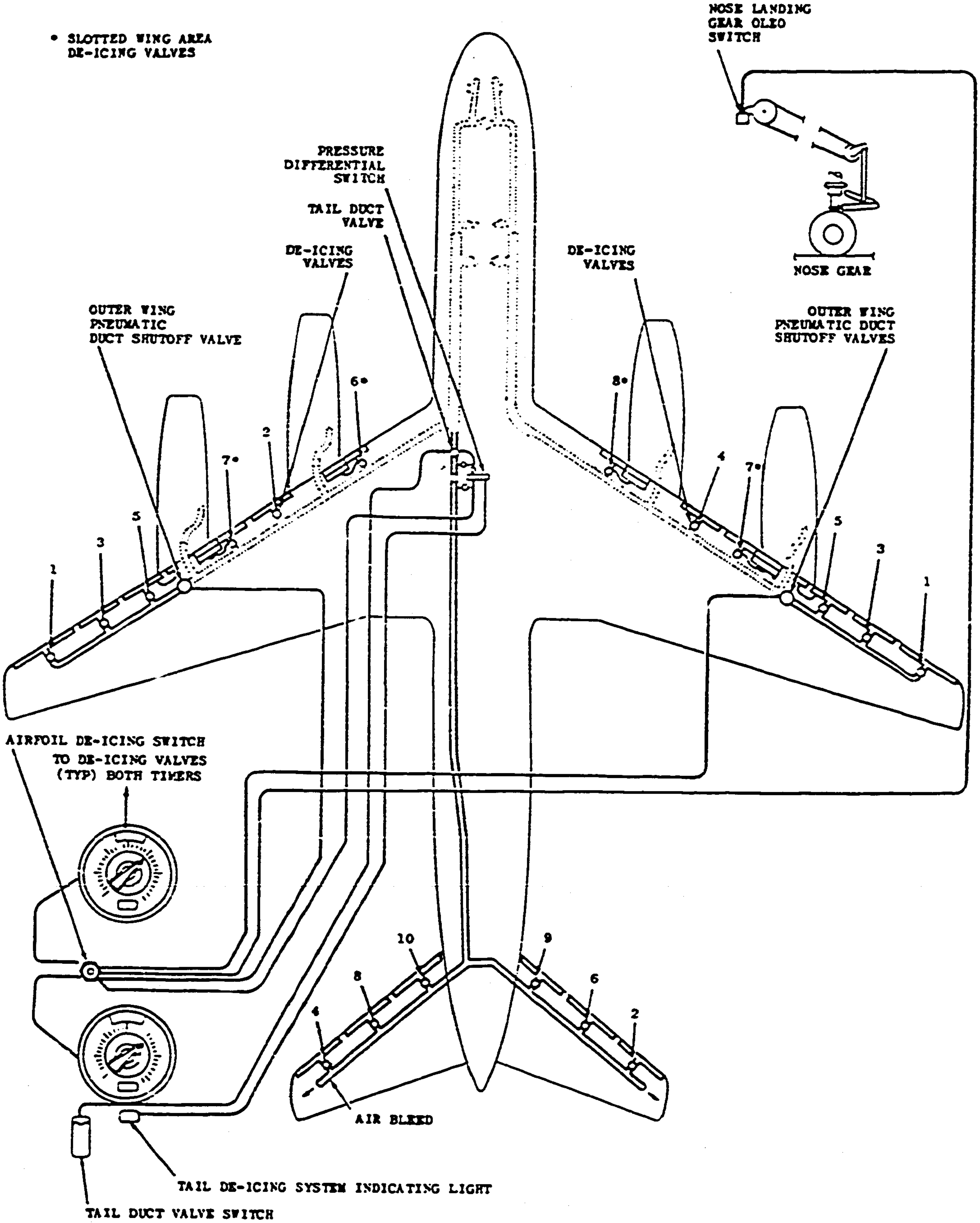
Airfoil Deicing System -- Schematic
(Airplanes 801-804)
Figure 1 (Sheet 1)

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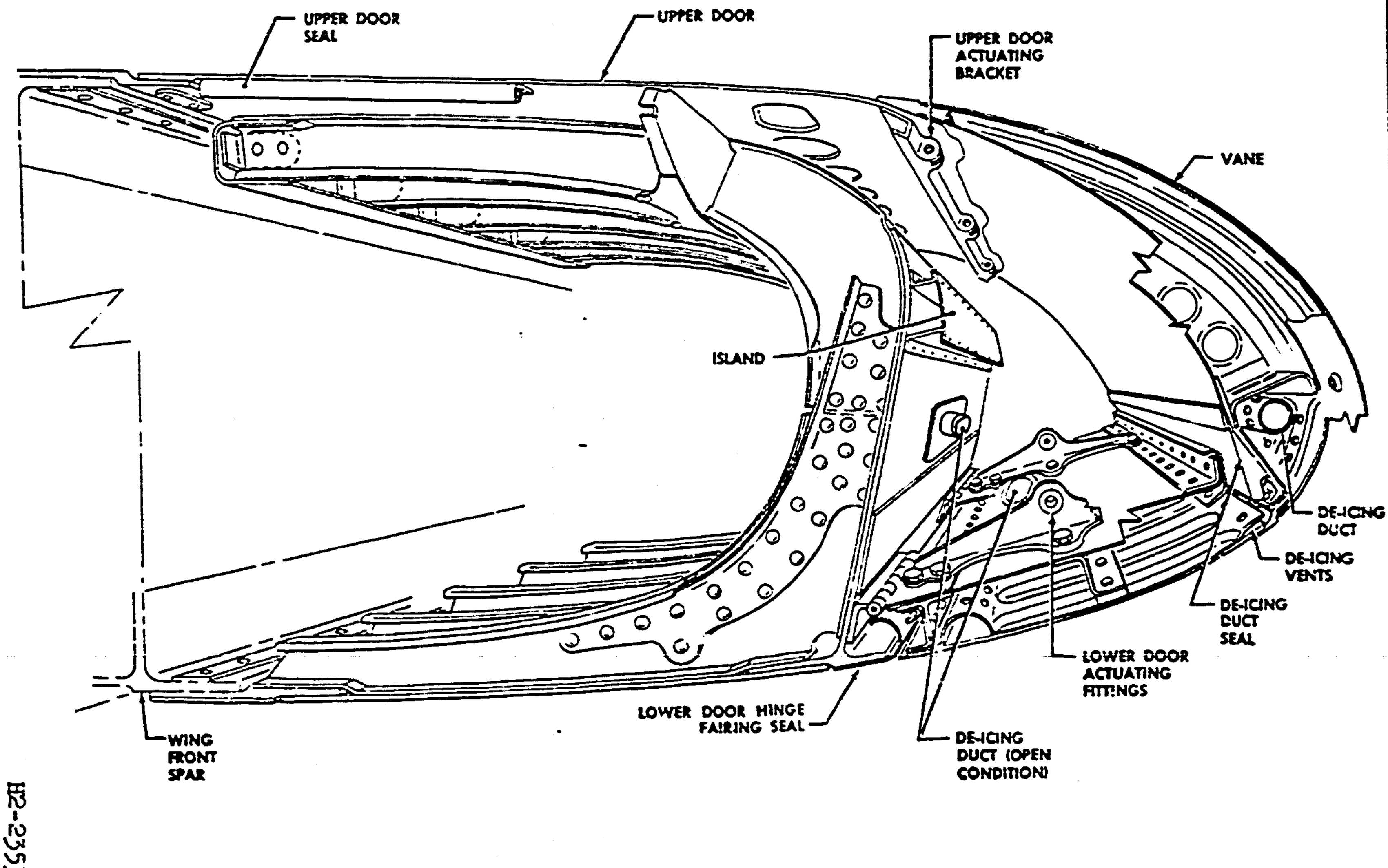


Airfoil Deicing System -- Schematic
(Airplanes 805-817)
Figure 1 (Sheet 2)

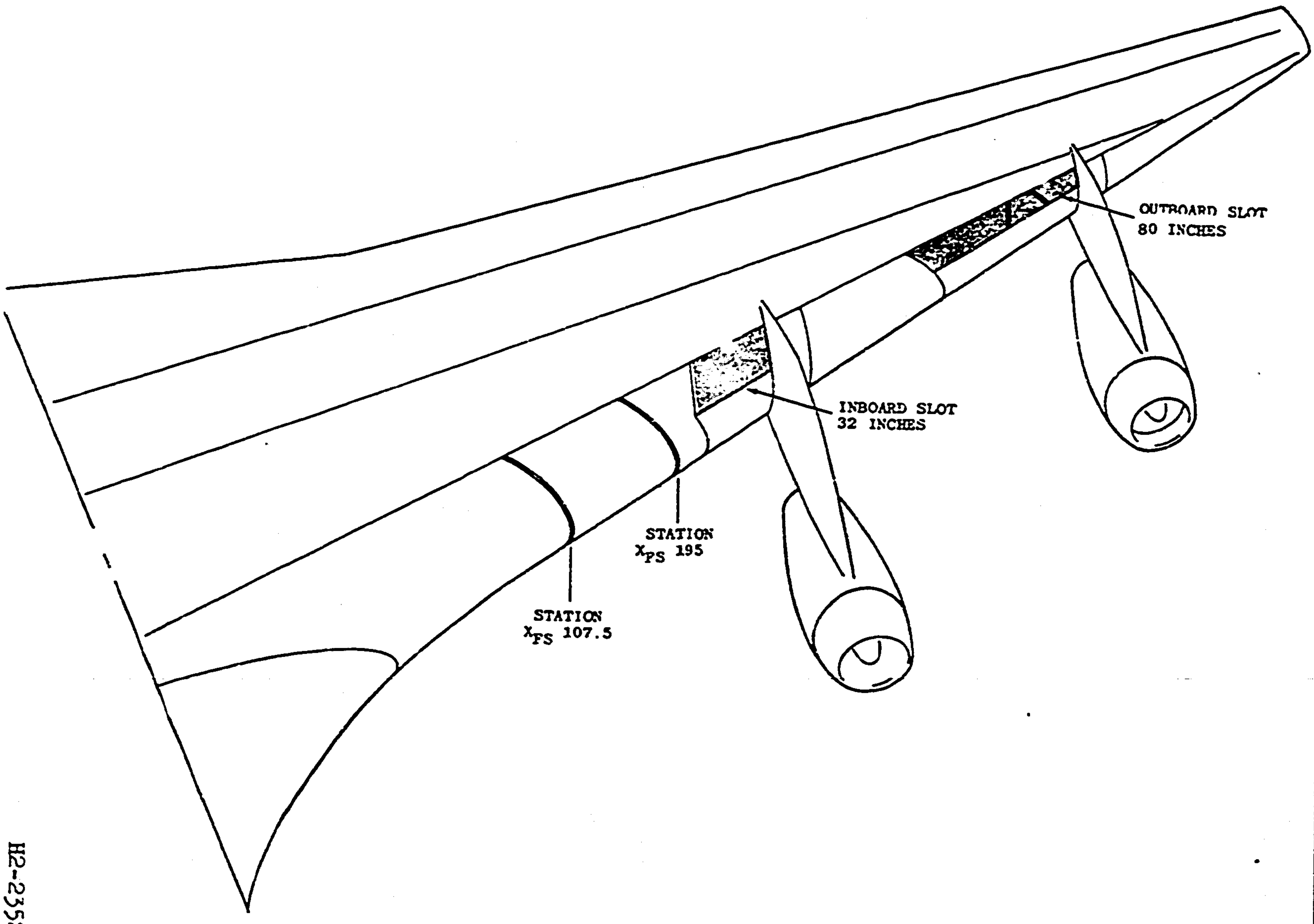


HA2-1683

Airfoil Deicing System -- Schematic
(Airplanes 818-822)
Figure 1 (Sheet 3)



Wing Leading Edge Slot Assembly
Figure 2



H2-2352

Wing Leading Edge Slots
Figure 3

low-pressure pneumatic manifold, air is directed to the left and right outer wings (outboard of No. 1 and 4 pylons) through the outer wing pneumatic duct shutoff valves, and to the empennage through the tail duct valve and the tail duct. The tail duct extends from the tail duct valve in the fuselage to the tail section of the airplane. This duct is located on the left side of the fuselage below the floor, in the pressurized area, and extends into the horizontal stabilizer. D-ducts in each airfoil leading edge are divided into a total number of sections corresponding to the total number of deicing valves (see paragraph B) and direct the distribution of air to through the leading edge areas which are to be deiced. All D-ducts are riveted to ribs located in the wing and stabilizer leading edges, and are removed and installed as integral components of the leading edge structure (see Chapters 55 and 57). The deicing air exhausts overboard from the wing leading edges through slots in the lower surface between pylons. Air from the horizontal stabilizer leading edges exhausts into the tail cone and overboard through slots in the tail cone, the elevator torque tube, and the horizontal stabilizer torque box.

G. V-band clamps and flexible connectors connect the tail duct sections. The flexible connectors in the pressurized area are a double-walled type, similar to the connectors used in the pneumatic manifold (see Chapter 36) with the exception of the attaching flanges. The connectors in the nonpressurized area (tail section) are a single-walled type attached to the beaded ends of the duct with clamps.

H. The tail duct is connected to a Y-duct in the horizontal stabilizer with a flexible connector located at the pivot of the stabilizer. This connector allows the duct to flex with stabilizer movement. The ducts in the stabilizer leading edge have three deicing ports on each side of the stabilizer. Deicing valves are connected to these ports and to the D-duct sections in the leading edge. A bleed orifice is located near the outboard end of the ducts. Air from the tail duct bleeds into the leading edge area from these orifices, insuring a hot air supply to all tail deicing valves when the tail duct valve is open.

I. A flow-limiting venturi, located just downstream of the tail duct valve, provides a pressure signal for the tail duct valve differential pressure switch. Two sensing lines are connected across the venturi, one at the throat and one immediately upstream of the venturi.

J. The outer wing ducts extend from the outer wing pneumatic duct shutoff valves connected to the pneumatic manifold (outboard of No. 1 and 4 pylons) to the wing tips. An anti-icing air outlet is located near the outboard end of each duct. The two ducts are composed of sections connected with clamps and single wall flexible connectors. Each section is supported by a fixed and a slip-type bracket. The fixed bracket holds the duct section rigid where the deicing valves attach to the deicing air outlets. The slip supports allow the duct to expand and contract and also allow for structural deflections.

K. The airfoil deicing controls and indicating light system provides for electrical control and monitoring of the deicing of the wing and tail surfaces. The system controls and indicating light are located on the main instrument panel and include the following:

(1) Airfoil deicing switch, with timer 1, timer 2, and off positions.

(2) Two airfoil timers (these also act as cycle sequence indicators).

(3) Tail deicing system indicating light.

(4) Tail duct valve switch, 3 positions - normal, override, and off (airplanes 801-814), 2 positions - normal and off (airplanes 805 and subsequent).

(5) Tail duct valve test switch (airplanes 801-817 only).

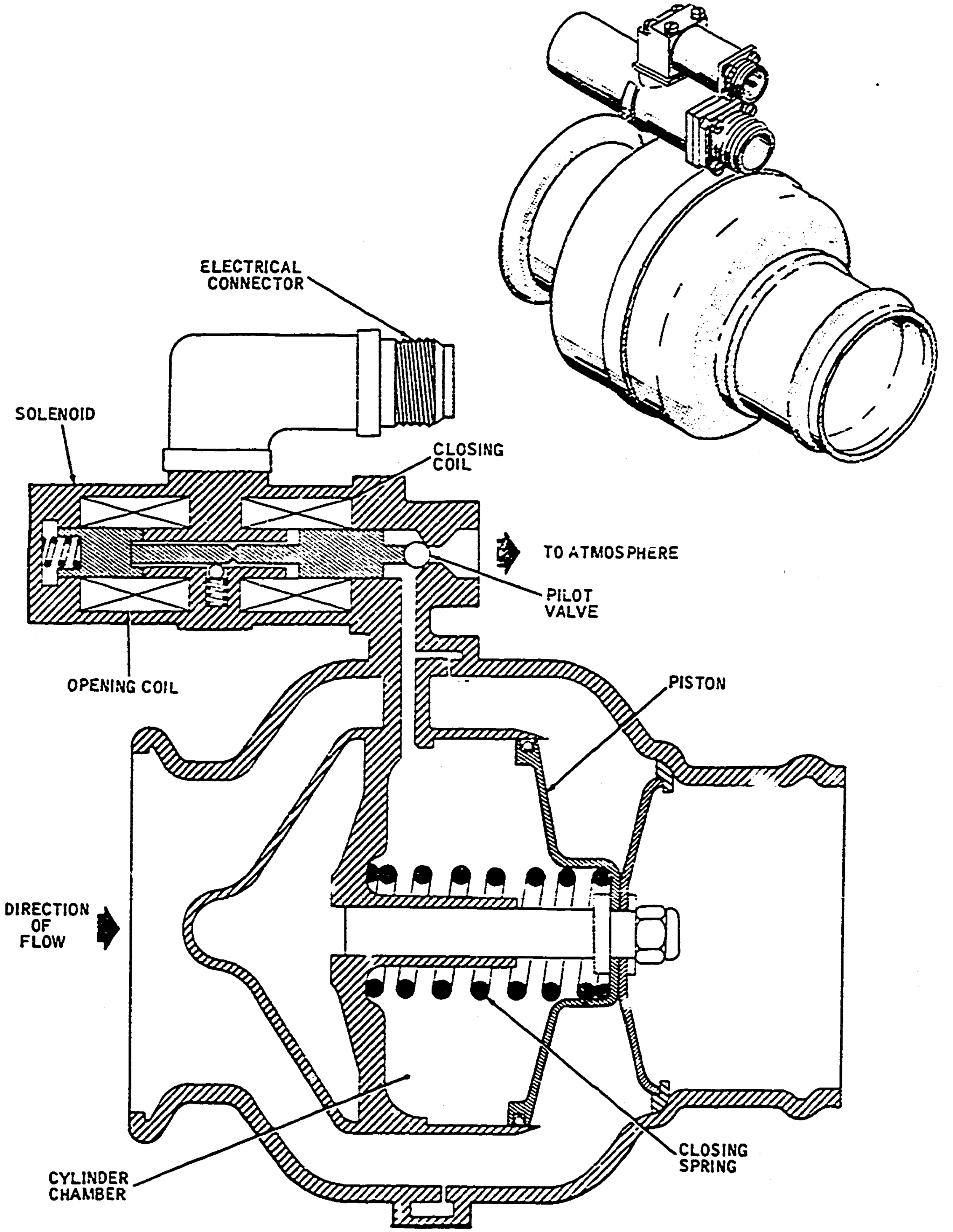
2. Component Description

A. Outer Wing Pneumatic Duct Shutoff Valve (See Figure 4.)

(1) An outer wing pneumatic duct shutoff valve is installed between the low-pressure pneumatic manifold and the outer wing pneumatic duct.

(2) It is an electrically controlled, pneumatically actuated, poppet-type valve. The valve operates when the pneumatic manifold is pressurized and electrical power is directed to the valve by either the airfoil deicing system or the anti-icing system.

(3) When electrical power is supplied to the open winding of the valve solenoid by one of the above systems, air pressure from the pneumatic system opens the valve. As long as pneumatic power is supplied, the valve remains open until the close winding of the valve solenoid is energized. When the valve opens, air from the pneumatic system is directed to the outer wing pneumatic duct. The duct supplies air to the outer wing deicing valves and to the outer wing vent scoop.



Outer Wing Pneumatic Duct Shutoff Valve -- Schematic
Figure 4

B. Tail Duct Valve (See Figure 5.)

(1) The tail duct valve controls the air supply to the deicing and anti-icing ducts and components of the horizontal stabilizers. The valve is open only when the airfoil deicing system is operating. It is located in the forward end of the tail duct at the juncture of the wing and fuselage sections of the airplane pneumatic manifold (left side).

(2) The valve is an electrically controlled, pneumatically actuated butterfly valve, requiring both electrical and pneumatic power to open. The valve closes any time electrical power is removed from the solenoid, even in the absence of pneumatic power.

C. Airfoil Deicing Valve (See Figures 6 and 7.)

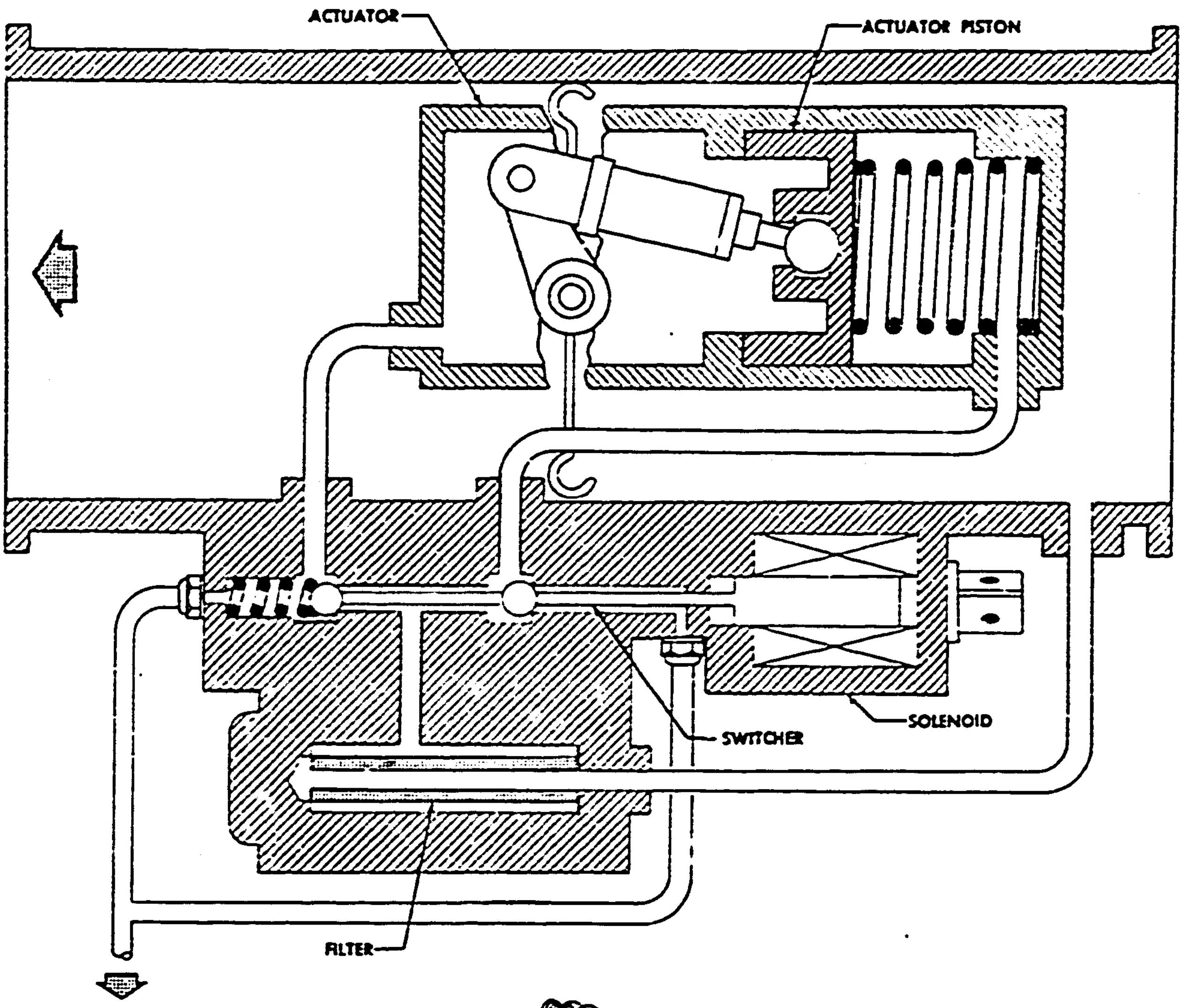
(1) Airfoil deicing valves are used in the deicing system to cycle air from the pneumatic ducts to the D-ducts that are located in the leading edge of the wings and stabilizer. The D-ducts are divided into sections and each section is supplied with air from the pneumatic duct system through a deicing valve. The valves are attached to the supply duct with V-band clamps and are connected to their respective D-duct section with a flexible connector and a band-type clamp.

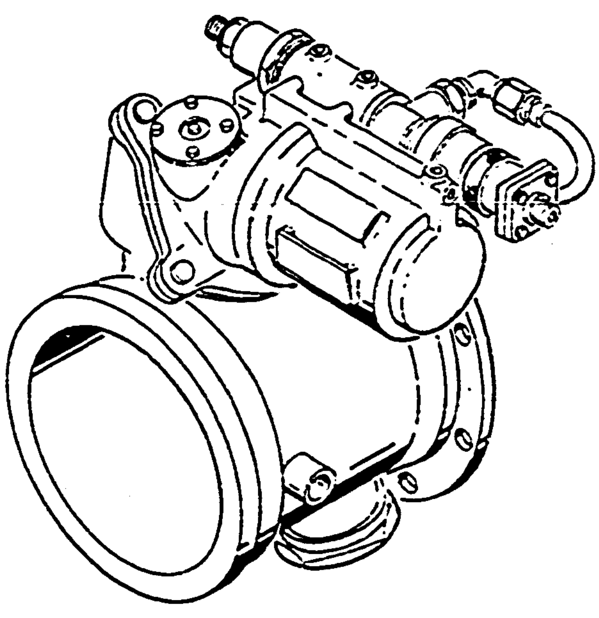
(2) All deicing valves are electrically controlled and pneumatically actuated. Air from the low-pressure pneumatic system is always available the center-wing and inner-wing valves when the pneumatic manifold is pressurized. Air from the pneumatic system is available to the outer-wing valves and to the stabilizer when, during operation of the deicing or anti-icing system, the tail duct valve and the outer wing pneumatic duct shutoff valves are open. The valves return to the normally-closed position when electrical power is removed from the solenoid.

D. Airfoil Deicing Timers (See Figure 8.)

(1) The airfoil deicing timers control the on-off cycling of the airfoil deicing valves. Two timers are mounted on the main instrument panel. One timer acts as the standby while the other one is connected in the circuit through the airfoil deicing switch.

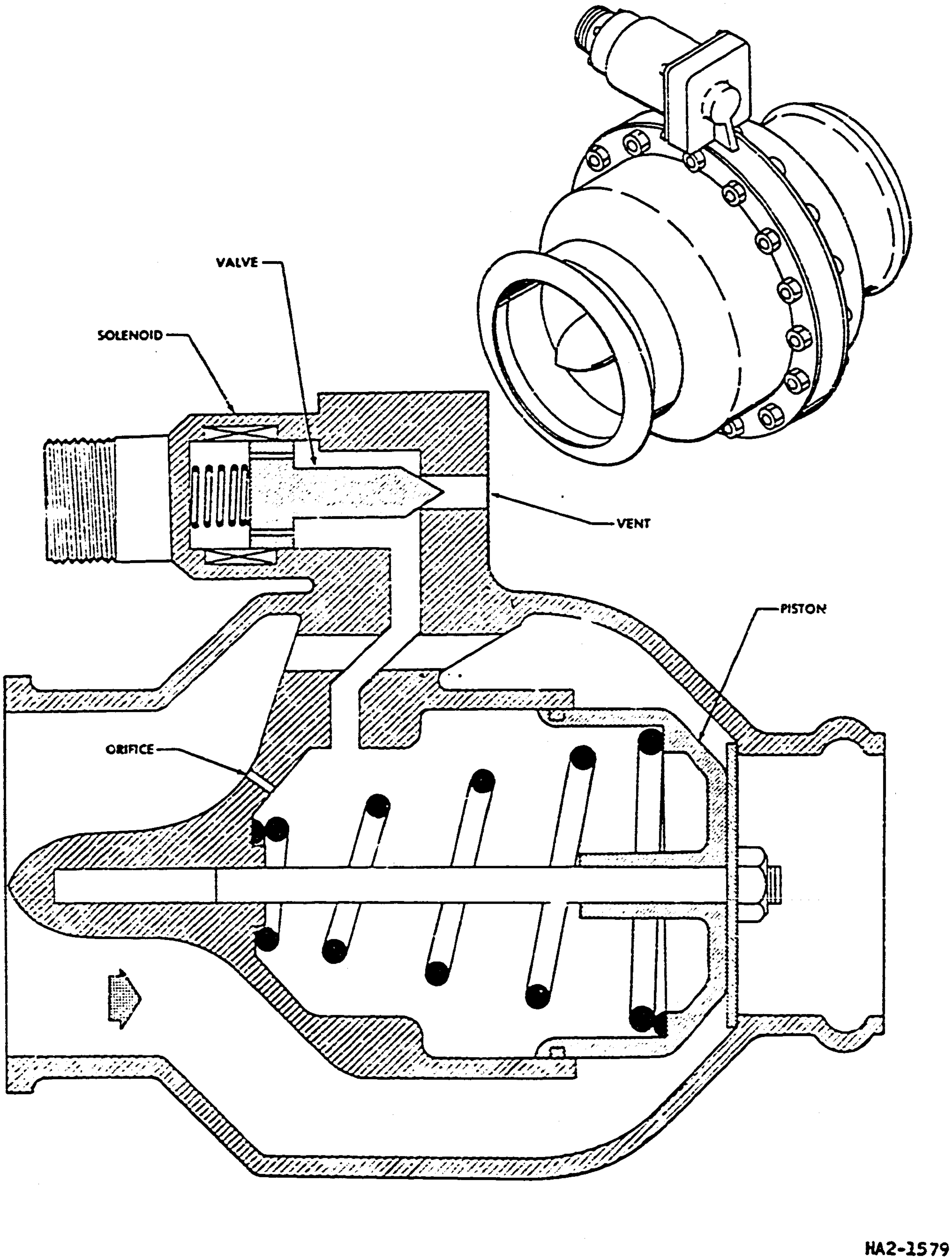
(2) The timers have an airfoil deicing timer cycle selector knob and an airfoil deicing timer temperature selector knob. The dial is graduated from 0° to -30°C for ram-air temperature selections. The switch-actuating camshaft in the timer is driven faster or slower by a variable speed drive that is controlled by the temperature selector knob. When the deicer timer selector knob is placed in the test position, the timer will go through the complete cycle in 23 to 31 seconds. The manually-set cycle selector knob determines cycle time according to the ram-air temperature indication. The cycle time can be doubled by pulling out and turning the cycle selector knob from the normal cycle to the long cycle position.



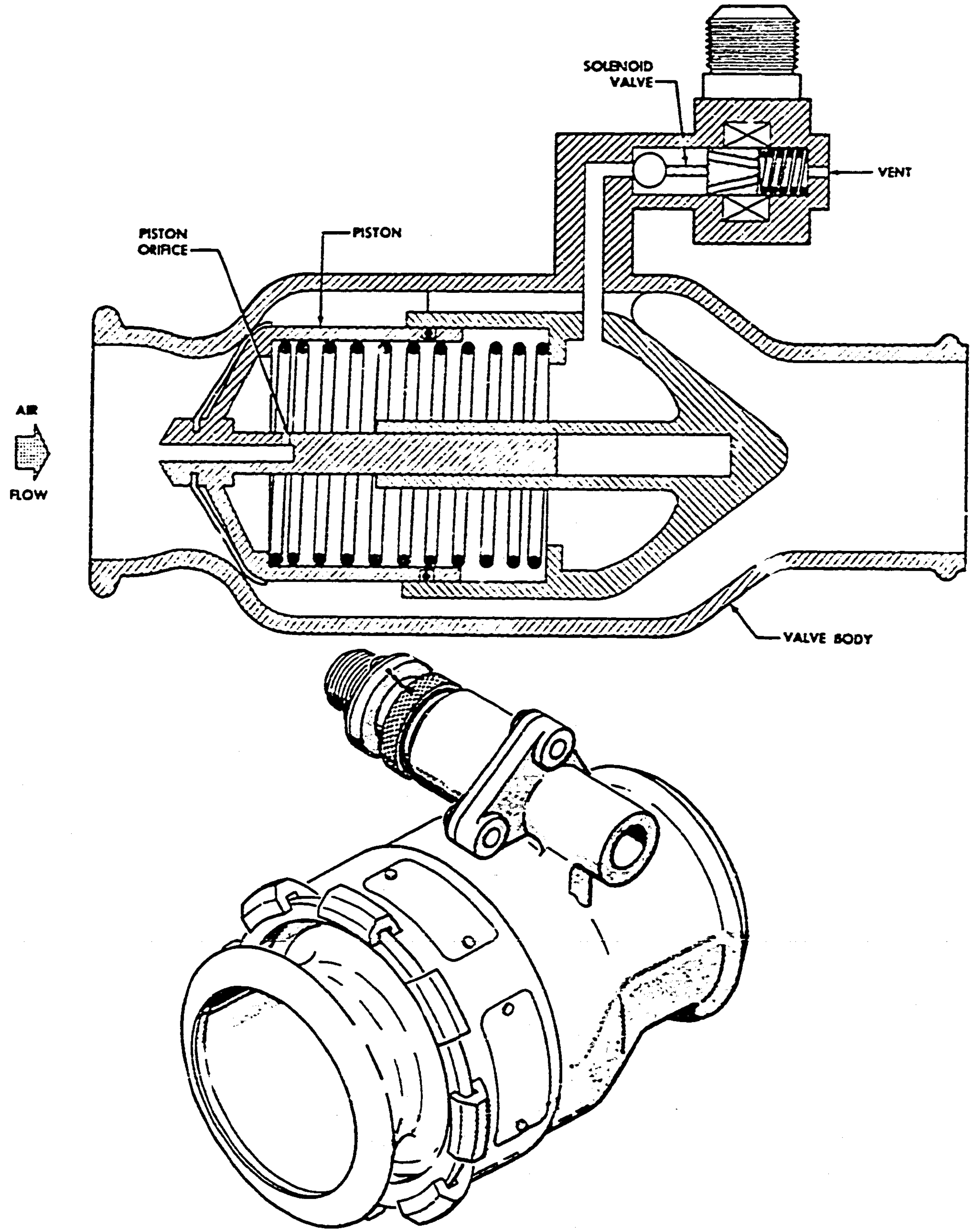


HA2-1577

Tail Duct Valve -- Schematic
Figure 5

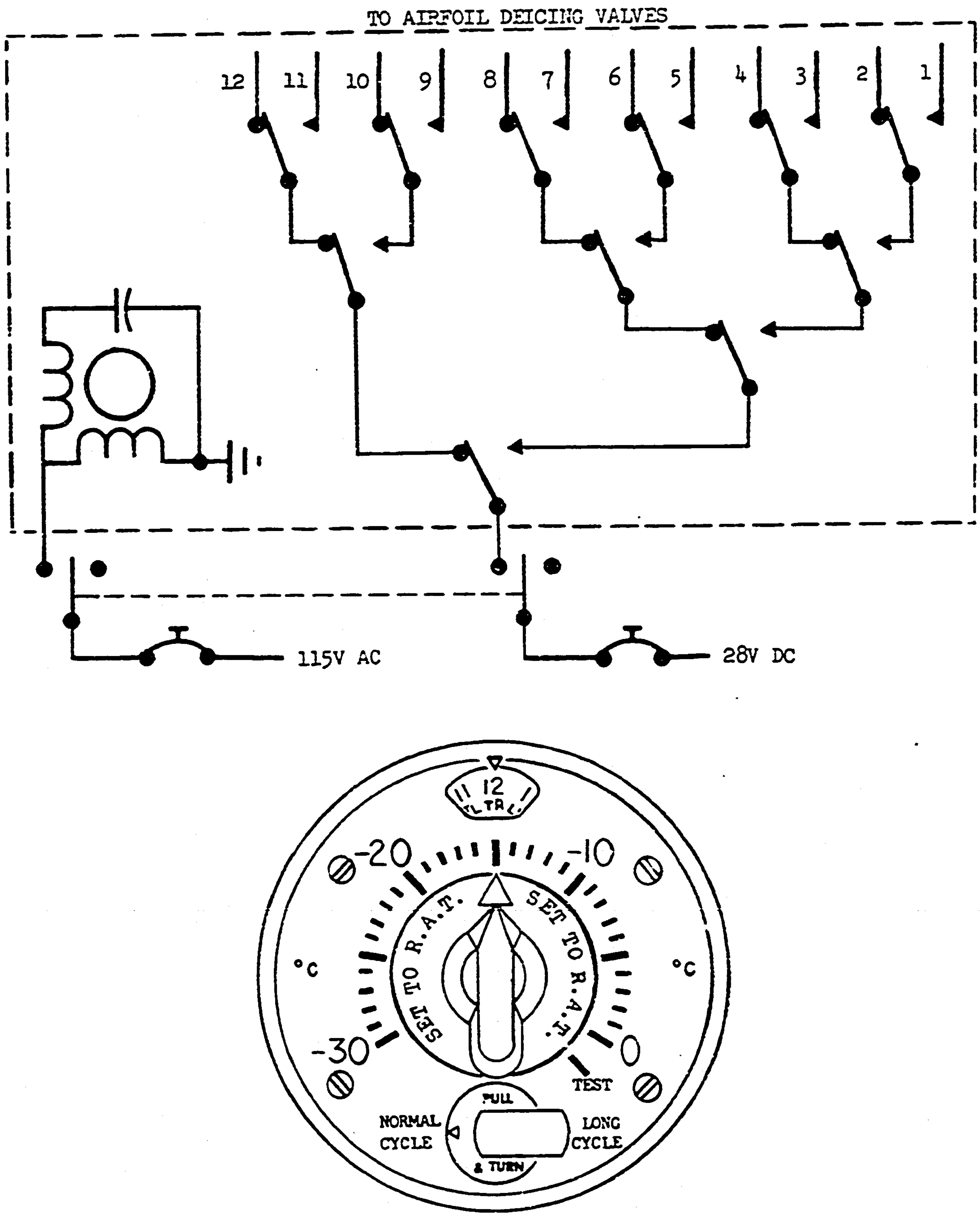


Inner Wing Deicing Valve -- Schematic
Figure 6



HA2-1578

Outer Wing Deicing Valve -- Schematic
Figure 7



HA2-1580

Airfoil Deicing Timer -- Functional
Figure 8

(3) A portion of a dial is seen through a window in the face of the timer. The number of the airfoil deicing valve that should be open at any given time appears in the window of the timer.

E. Tail Duct Venturi Differential-Pressure Switch (See Figure 9.)

(1) The tail duct venturi differential-pressure switch is installed in the airfoil deicing system to operate an amber indicating light in the flight compartment. The differential-pressure switch, connected to the venturi downstream of the tail duct valve, senses any malfunction in the tail section that causes high airflow, and completes an electrical circuit to operate the indicating light. Differential-pressure across the tail duct venturi actuates a diaphragm to which the load contacts are connected.

3. Operation

A. The airfoil deicing system is set in operation by placing the following controls in the noted positions:

Tail duct valve switch .... normal

Airfoil deicing timer cycle selector knob .... normal cycle

Airfoil deicing timer temperature selector knob .... at ram-air temperature

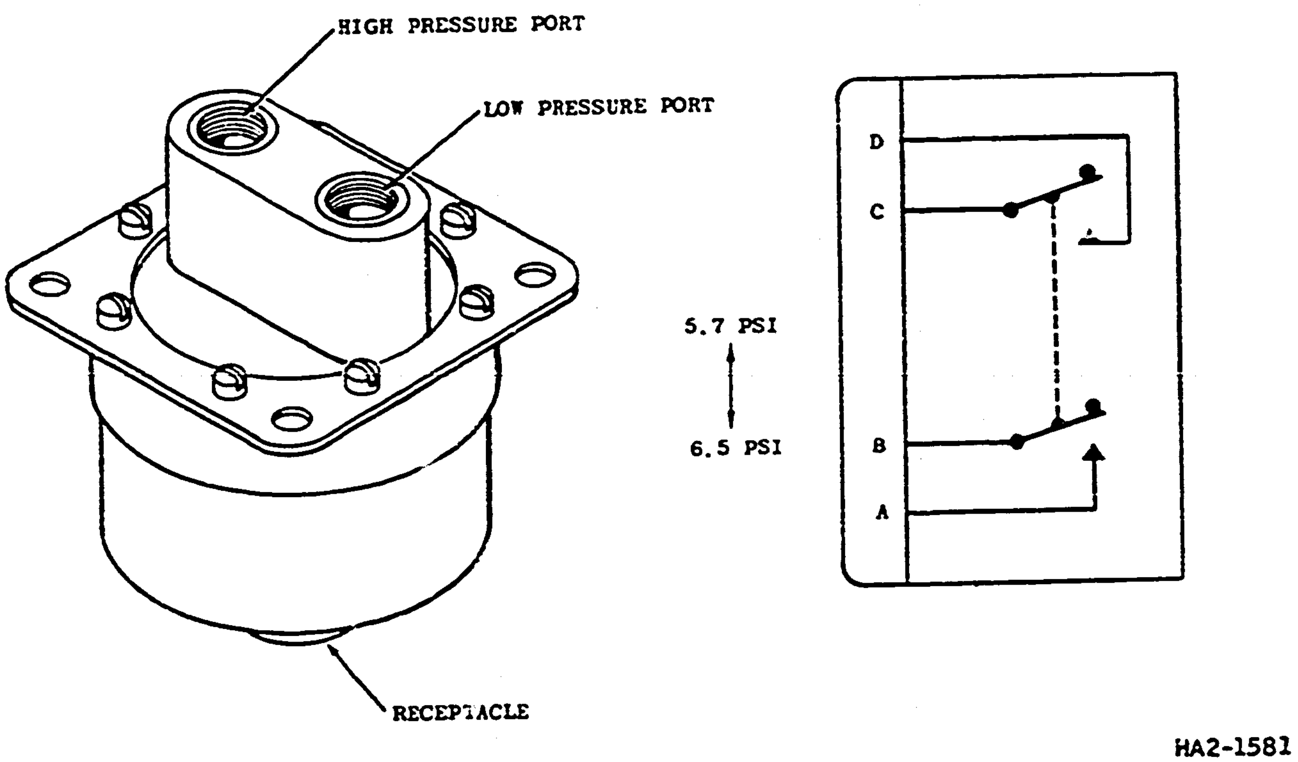
Airfoil deicing switch .... timer 1 or timer 2

NOTE: The deicing valves are deactivated on the ground through the operation of the left air-conditioning ground control relay. This feature is incorporated in the system to avoid overheating the structure. For ground operation, see Maintenance Practices, this section.

B. When the airfoil deicing switch is placed in timer 1 or timer 2 position, air from the supply ducts and the manifold is directed to the airfoil leading edges and wing leading edge slots through the deicing valves. These valves are electrically controlled by the selected timer to supply air to one or more sections of the D-duct in the leading edge of each airfoil. Through the action of the timer, air is supplied intermittently and in sequence to corresponding sections of the D-duct. This action electrically controls the opening and closing rate of the deicing valves. One deicing cycle is completed when all leading edge areas have received deicing air. This cycle is repeated until the airfoil deicing switch is placed in the off position.

C. To prevent the formation of runback ice, and to shed secondary ice, an airfoil deicing timer cycle selector knob, is provided at the bottom of the timer dial for selecting a normal cycle or a long cycle. When the knob is positioned from normal cycle to long cycle prior to turning off the deicing system, the length of time that the deicing valves remain open is doubled. A small portion of a rotating dial is visible in a window at the top of the timer. The identifying number of the airfoil deicing valves that should be open at any given time appears in the window of the timer. The letter adjacent to the number indicates the general location of the valves; for example, L for left wing, R for right wing, and T for tail.

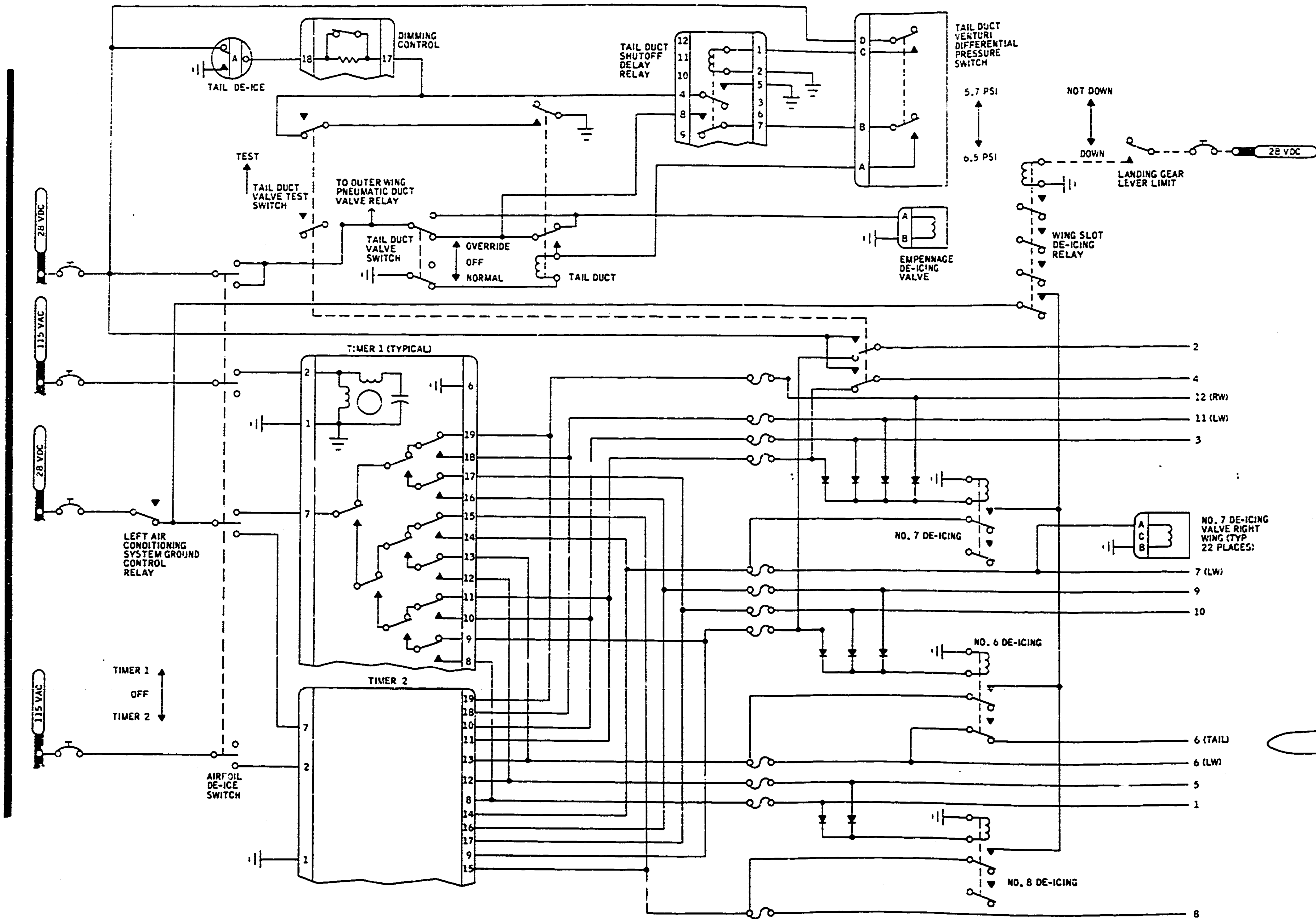
D. During approach and landing operations, it is necessary that the wing slot areas be deiced more frequently than the unslotted areas. When the landing gear control lever is placed in the down position, the slotted area deicing valves open for three extra intervals during the same time that all the valves are operating in their regular sequence. With the landing gear control lever in this position, the fuselage nose anti-icing valves are locked closed to conserve engine bleed air.



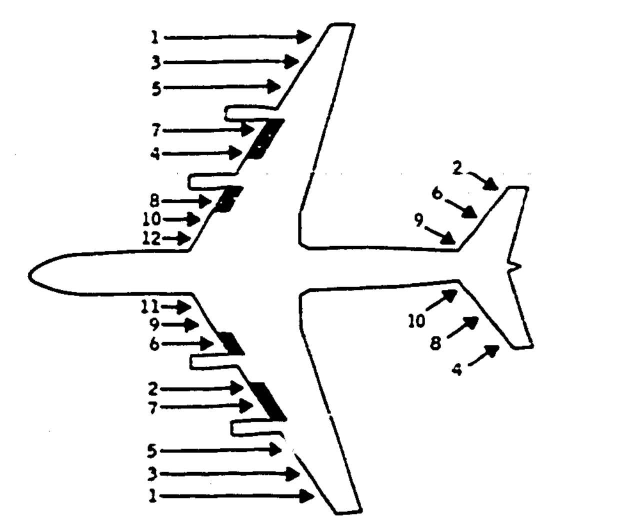
Tail Duct Venturi Differential-Pressure -- Switch
Figure 9

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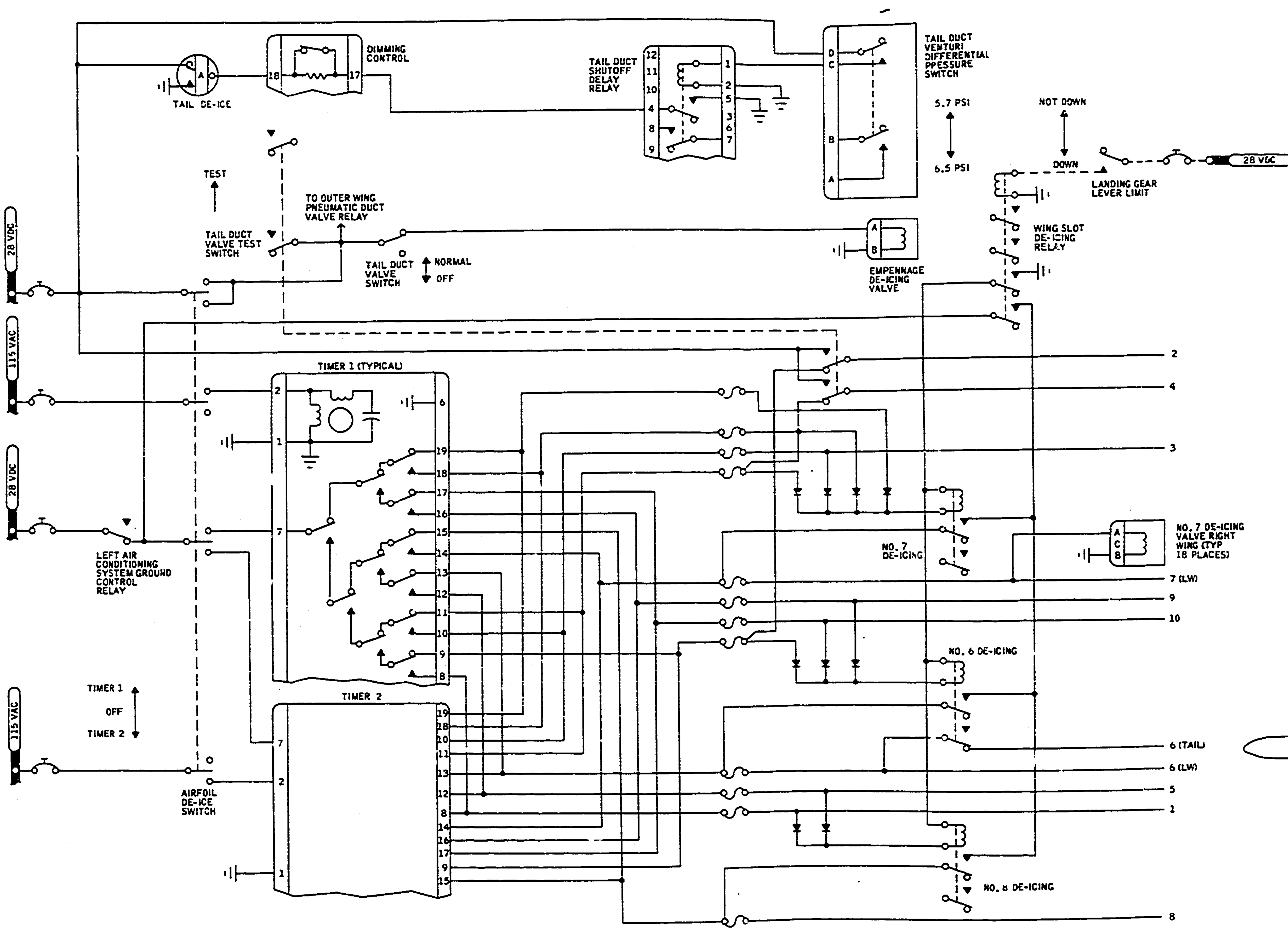


TIMER POSITION	SLOT DE-ICING CYCLE VALVES	
	NORMAL	TRIPLE
1	1 L & RW	1 L & RW 8 RW & T
2	2 LW & T	2 LW & T 6 LW
3	3 L & RW	3 L & RW 7 L & RW
4	4 RW & T	4 RW & T 7 L & RW
5	5 L & RW	5 L & RW 8 RW & T
6	6 LW & T	6 LW & T
7	7 L & RW	7 L & RW
8	8 RW & T	8 RW & T
9	9 LW & T	9 LW & T 6 LW
10	10 RW & T	10 RW & T 6 LW
11	11 LW	11 LW 7 L & RW
12	12 RW	12 RW 7 L & RW

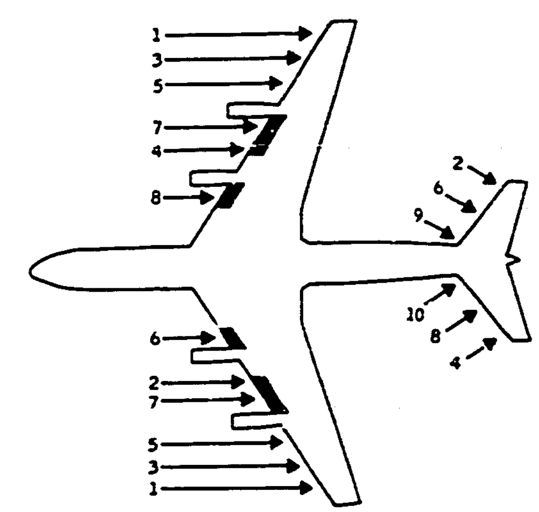


Airfoil Deicing System - Electrical Schematic
(Airplanes 801-804)
Figure 10 (Sheet 1)

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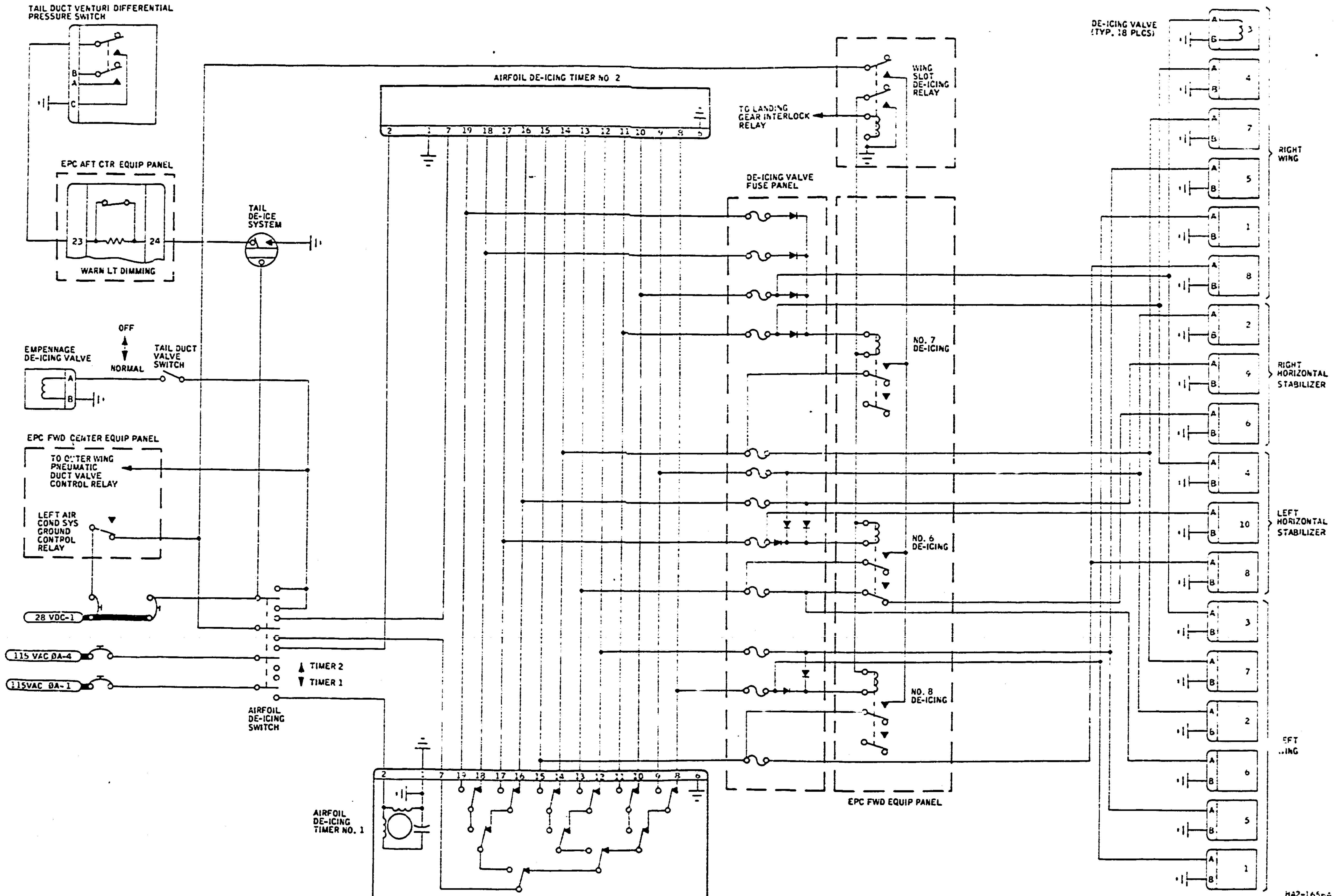


TIMER POSITION	SLOT DE-ICING CYCLE VALVES	
	NORMAL	TRIPLE
1	1 R & LW	1 R & LW 8 RW & T
2	2 LW & T	2 LW & T 6 LW
3	3 L & RW	3 L & RW 7 L & RW
4	4 RW & T	4 RW & T 7 L & RW
5	5 L & RW	5 L & RW 8 RW & T
6	6 LW & T	6 LW & T
7	7 L & RW	7 L & RW
8	8 RW & T	8 RW & T
9	9 T	9 T 6 LW
10	10 T	10 T 6 LW
11		7 L & RW
12		7 L & RW



HA2-4956

Airfoil Deicing System -- Electrical Schematic
(Airplanes 805-817)
Figure 10 (Sheet 2)



Airfoil Deicing System -- Electrical Schematic
(Airplanes 818-822)
Figure 10 (Sheet 3)

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AIRFOIL - TROUBLE SHOOTING

1. General

A. The airfoil deicing timers and applicable system circuit breakers are located in the flight compartment. The airfoil deicing valves are located along the leading edges of the wing and horizontal stabilizer.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Multimeter	260	Simpson	Make voltage and continuity checks.
B	Wing Slot Deicing System Line Checker	4767460-501	Douglas Aircraft Company	Alternate trouble shooting method of wing slot deicing system. (See Paragraph 4.)

3. Trouble Shooting

Possible Causes	Isolation Procedure	Correction
A. AIRFOIL DEICING TIMER WINDOW INDICATES NO TIMER MOTOR OPERATION		
(1) Airfoil deicing timer circuit b .aker open.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2) Defective timer.	Substitute one timer for the other by physically interchanging. Then repeat timer operation.	Replace timer if defective.
(3) Defective electrical wiring; defective airfoil deicing switch.	Check continuity of wiring or switch.	Repair or replace electrical wiring; replace switch.

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Possible Causes	Isolation Procedure	Correction
B. ALL AIRFOIL DEICING VALVES FAIL TO OPERATE ALTHOUGH BOTH TIMERS FUNCTION PROPERLY		
(1) Airfoil deicing valves circuit breaker open.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2) Left air conditioning system ground control relay failed to deenergize (in flight)	Test airfoil deicing system (see Adjustment/Test).	Replace relay if defective.
(3) Defective airfoil deicing switch; defective electrical wiring.	Check continuity of switch or wiring.	Replace switch if defective; repair or replace wiring.
C. AIRFOIL DEICING VALVES CIRCUIT BREAKER OPENS AS TIMER OPERATES THROUGH CYCLE (MAY OCCUR WITH EITHER TIMER)		
(1) Short circuit between applicable timer and fuse.	Operate applicable timer. Observe valve number which appears in timer window as circuit breaker opens. Check electrical wiring between timer and fuse for that particular valve.	Repair or replace electrical wiring.
D. ONE TIMER FAILS TO DIRECT ELECTRICAL POWER TO ANY DEICING VALVE		
(1) Defective timer.	Substitute one timer for the other by physically interchanging. Then repeat timer operation.	Replace timer if defective.

Possible Causes	Isolation Procedure	Correction
D. ONE TIMER FAILS TO DIRECT ELECTRICAL POWER TO ANY DEICING VALVE (Continued)		
(2) Defective airfoil deicing switch. NOTE: With this condition, and with pneumatic manifold pressurized and both timers turned off, deicing air may be flowing from valves No. 6, 7, and 8.	Check switch for continuity.	Replace switch if defective.
(3) Defective electrical wiring between airfoil deicing switch and applicable timer.	Check electrical wiring for continuity.	Repair or replace wiring.
E. AN AIRFOIL DEICING VALVE OPERATES DURING CYCLING OF ONE TIMER, BUT NOT DURING CYCLING OF OTHER TIMER		
(1) Malfunctioning timer	Substitute one timer for the other by physically interchanging. Then repeat timer operation.	Replace timer if defective.
(2) Open circuit between timer and fuse.	Check electrical wiring between timer and fuse of circuit suspected to be faulty.	Repair or replace electrical wiring.

Possible Causes	Isolation Procedure	Correction
F. AN AIRFOIL DEICING VALVE FAILS TO OPERATE DURING CYCLING OF EITHER TIMER; NO LIGHT IN FUSE CAP FOR THIS VALVE		
(1) Open circuit between applicable fuse and terminal strip in aft accessory compartment.	Check for electrical power at terminal strip.	Repair or replace electrical wiring.
(2) Open circuit between terminal strip and ground.	Check continuity from terminal strip to ground.	Repair or replace electrical wiring.
NOTE: This would include valve solenoid winding and pigtail which grounds valve to airplane.		Replace valve if solenoid winding is open.
(3) Valve stuck closed	(See correction.)	Replace valve.

Possible Causes	Isolation Procedure	Correction
G. AIRFLOW IS ABSENT FROM VALVE(S), ALTHOUGH BOTH TIMERS HAVE BEEN OPERATED TO POSITION CORRESPONDING TO VALVE(S) IN QUESTION; FUSE CAP LIGHT FOR VALVE(S) IS ON; MANIFOLD IS PRESSURIZED		
(1) Short circuit between fuse input terminal and ground. NOTE: This would include valve solenoid winding and pigtail which grounds valve to airplane.	Stop timers at desired valve position by opening timer motor circuit breakers. Disconnect applicable electrical wires from terminal strip located in accessory compartment. Replace fuse if necessary. Turn on airfoil deicing switch.	If fuse cap light comes on, repair or replace wiring between fuse and terminal strip. If fuse cap light remains out, repair or replace wiring or components as necessary between terminal strip and ground (including valve and pigtail).
H. AIRFLOW IS ABSENT FROM ONE VALVE WHICH NORMALLY OPERATES SIMULTANEOUSLY WITH ANOTHER VALVE; OCCURS WITH EITHER TIMER		
(1) Defective electrical wiring between terminal strip and valve electrical connector; defective valve solenoid or pigtail which grounds valve to airplane.	Check for electrical power at valve electrical connector.	If no power present, repair or replace wiring. If power present, repair or replace valve or pigtail as necessary.
I. CONTINUOUS AIRFLOW FROM A VALVE (WITHOUT TIMER OPERATION)		
(1) Wing deicing valve (supplied directly from pneumatic manifold) stuck open.	Inspect valve for evidence of being stuck open (see 30-10-3).	Replace valve if defective.

Possible Causes	Isolation Procedure	Correction
I. CONTINUOUS AIRFLOW FROM A VALVE (WITHOUT TIMER OPERATION) (Continued)		
(2) Defective airfoil deicing switch.	Check switch for continuity.	Replace switch if defective.
J. CONTINUOUS AIRFLOW FROM A VALVE (ONLY DURING TIMER INSTALLATION)		
(1) Valve stuck open in outer wing or in empennage.	Inspect valve for evidence of being stuck open (see 30-10-3).	Replace valve if defective.
K. AIR FLOWS FROM OUTER WING AND EMPENNAGE BLEED ORIFICES WHEN AIRFOIL DEICING SWITCH TURNED OFF, AND TAIL DUCT VALVE SWITCH PLACED IN NORMAL POSITION		
(1) Short circuit in airfoil deicing switch.	Open empennage deicing and warning circuit breaker. Disconnect electrical wire from X2 of outer wing pneumatic duct valve control relay (see 30-00).	If no continuity, replace airfoil deicing switch.
L. AIR FLOWS FROM EMPENNAGE BLEED ORIFICES WHEN AIRFOIL DEICING SWITCH TURNED OFF, AND TAIL DUCT SWITCH PLACED IN NORMAL POSITION		
(1) Tail duct valve stuck open.	Check tail duct valve (see 30-10-2).	Replace valve if defective.
M. DEICING AIRFLOW ABSENT FROM ALL EMPENNAGE DEICING VALVES		
(1) Open empennage deicing and warning circuit breaker.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.

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Possible Causes	Isolation Procedure	Correction
M. DEICING AIRFLOW ABSENT FROM ALL EMPENNAGE DEICING VALVES (Continued)		
(2) Tail duct valve stuck closed.	Check tail duct valve (see 30-10-2).	Replace valve if defective.
(3) Open circuit between tail duct valve and electrical bus.	Check for electrical power at valve electrical connector.	Repair or replace electrical wiring.
(4) Ruptured flexible duct connector.	Listen for sound of escaping air to locate defective connector.	Replace damaged connector.
N. NO AIRFLOW FROM ANY OUTER WING VALVE OR EMPENNAGE VALVE DURING SYSTEM OPERATION (USING EITHER TIMER)		
(1) Open empennage deicing and warning circuit breaker.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2) Open circuit between empennage deicing and warning circuit breaker and tail duct valve switch.	Check for electrical power at tail duct valve switch input terminal.	Repair or replace electrical wiring.

O. NO AIRFLOW FROM ANY OUTER WING VALVE DURING SYSTEM OPERATION (USING EITHER TIMER)

	Possible Causes	Isolation Procedure	Correction
(1)	Open circuit between tail duct valve switch and ground connection of outer wing pneumatic duct valve control relay.	Check for electrical power between XI and ground at relay.	Repair or replace electrical wiring; replace relay if defective.
(2)	Open circuit between outer wing pneumatic duct valves circuit breaker and terminal strip located in aft accessory compartment.	Check continuity of electrical wiring involved; check for contacts stuck open in outer wing pneumatic duct valve control relay and in scoops anti-icing switch.	Repair or replace electrical wiring; replace defective relay or switch as necessary.
(3)	Short circuit between outer wing pneumatic duct valves circuit breaker and ground at either outer wing pneumatic duct shutoff valve, causing above circuit breaker to open.	Disconnect electrical wires at terminal strip in aft accessory compartment. Check for continuity back to outer wing pneumatic duct valves circuit breaker. With circuit breaker open, no continuity should exist between electrical wiring and ground. Check for short circuit from terminal strip to ground through applicable outer wing pneumatic duct shutoff valve.	Repair or replace shorted electrical wiring. Replace shorted outer wing pneumatic duct shut-off valve, outer wing pneumatic duct valve control relay, or scoops anti-icing switch, as applicable.

Possible Causes	Isolation Procedure	Correction
P. NO AIRFLOW FROM OUTER WING VALVES OF ONE WING ONLY, DURING SYSTEM OPERATION (USING EITHER TIMER)		
(1) Open circuit between terminal strip located in aft accessory and ground at applicable outer wing pneumatic duct shutoff valve. This would include open and close windings of valve.	Disconnect both applicable electrical wires from terminal strip, and check for continuity through valve windings to ground.	Repair or replace shorted electrical wiring. Replace shorted valve if necessary.
Q. AIRFOIL DEICING VALVES OPERATE OUT-OF-SEQUENCE (SYSTEM IN NORMAL-CYCLE)		
(1) Shorted blocking rectifier (rectifier is conducting in reverse direction).	With system turned on, note which valve is operating out of sequence. Locate rectifier which is permitting electrical power to energize valve at incorrect time.	Replace rectifier.
R. AIRFOIL DEICING SYSTEM OPERATES IN TRIPLE-CYCLE ALTHOUGH TIMER CYCLE SELECTOR KNOBS ARE IN NORMAL-CYCLE POSITION		
(1) Shorted wing slot deicing relay.	Open airfoil deicing valves circuit breaker. Check for desired absence of continuity from D1 to D2 of wing slot deicing relay.	Replace relay if continuity exists.

Possible Causes	Isolation Procedure	Correction
R. AIRFOIL DEICING SYSTEM OPERATES IN TRIPLE-CYCLE ALTHOUGH TIMER CYCLE SELECTOR KNOBS ARE IN NORMAL-CYCLE POSITION (Continued)		
(2) Shorted landing gear lever limit switch.	Determine if landing gear lever limit switch has stuck closed by pulling landing gear control lever out of detent position (see Chapter 32). Landing-gear-unsafe warning light (s) should come on. CAUTION: ANY FURTHER MOVEMENT OF THE LEVER MAY CAUSE COLLAPSE OF NOSEGEAR.	Replace limit switch if defective.
S. AIRFOIL DEICING SYSTEM WILL NOT OPERATE IN TRIPLE-CYCLE		
(1) Open circuit breaker.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2) Defective wing slot deicing relay.	Check relay solenoid from X1 to ground for possible lack of continuity due to worn or damaged contacts.	Replace relay if defective.

Possible Causes	Isolation Procedure	Correction

T. CERTAIN AIRFOIL DEICING VALVES OPERATE OUT-OF SEQUENCE BY OPENING TOO OFTEN (SYSTEM IN TRIPLE-CYCLE)

Possible Causes	Isolation Procedure	Correction
(1) Shorted blocking rectifier (rectifier is conducting in reverse direction).	With system turned on, note which valves operate out of sequence. Locate rectifier which is permitting electrical power to energize valves at incorrect time.	Replace rectifier.

U. CERTAIN AIRFOIL DEICING VALVES OPERATE OUT-OF-SEQUENCE BY FAILING TO OPEN AT PROPER TIME (SYSTEM IN TRIPLE-CYCLE)

Possible Causes	Isolation Procedure	Correction
(1) Open blocking rectifier.	With system turned on, note which valves are failing to operate. Locate rectifier for respective valves.	Replace rectifier.

V. A WING SLOT DEICING VALVE REMAINS OPEN (SYSTEM IN TRIPLE-CYCLE)

Possible Causes	Isolation Procedure	Correction
(1) Shorted A1 to A2 contacts in No. 6, No. 7, or No. 8 deicing relay.	Determine which relay is malfunctioning by noting number of valve which remains open.	Replace relay.

W. A WING SLOT DEICING VALVE REMAINS CLOSED (SYSTEM IN TRIPLE-CYCLE)

Possible Causes	Isolation Procedure	Correction
(1) Shorted A2 to A3 contacts in No. 6, No. 7, or No. 8 deicing relay.	Determine which relay is malfunctioning by noting number of valve which remains closed.	Replace relay.

Possible Causes	Isolation Procedure	Correction
W. A WING SLOT DEICING VALVE REMAINS CLOSED (SYSTEM IN TRIPLE-CYCLE) (Continued)		
(2) Defective valve solenoid.	Determine by noting which valve is not operating properly.	Replace valve.
(3) Defective electrical wiring.	Check continuity of electrical wiring.	Repair or replace wiring.

4. Trouble Shooting Airfoil Deicing System -- Alternate Method

A. Trouble Shooting Airfoil Deicing System

(1) Using wing slot deicing system line checker, trouble shoot airfoil deicing system per instructions accompanying line checker.

NOTE: The line checker is inserted into the airplane system without disturbing the airplane wiring and may also be used to functionally check the airfoil deicing system.

AIRFOIL - TROUBLE SHOOTING

1. General

   A. The airfoil deicing timers and applicable system circuit breakers are located in the flight compartment. The airfoil deicing valves are located along the leading edge of the wing.

2. Tools and Equipment Required

   NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Multimeter	260	Simpson	Make voltage and continuity checks.
B	Wing Slot Deicing System Line Checker	4767460-501	Douglas Aircraft Company	Alternate trouble shooting method of wing slot deicing system. (See Paragraph 4.)

3. Trouble Shooting Airfoil Deicing System

Possible Causes	Isolation Procedure	Correction
A. AIRFOIL DEICING TIMER WINDOW INDICATES NO TIMER MOTOR OPERATION		
(1) Airfoil deicing timer circuit breaker open.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2) Defective timer.	Substitute one timer for the other by physically interchanging them. Then repeat timer operation.	Replace timer if defective.
(3) Defective electrical wiring; defective airfoil deicing switch.	Check continuity of wiring c. switch.	Repair or replace electrical wiring; replace switch.

Possible Causes	Isolation Procedure	Correction
B. ALL AIRFOIL DEICING VALVES FAIL TO OPERATE ALTHOUGH BOTH TIMERS FUNCTION PROPERLY		
(1) Airfoil deicing valves circuit breaker open.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2) Left air conditioning system ground control relay failed to deenergize (in flight)	Test airfoil deicing system (see Adjustment/Test).	Replace relay if defective.
(3) Defective airfoil deicing switch; defective electrical wiring.	Check continuity of switch or wiring.	Replace switch if defective; repair or replace wiring.
C. AIRFOIL DEICING VALVES CIRCUIT BREAKER OPENS AS TIMER OPERATES THROUGH CYCLE (MAY OCCUR WITH EITHER TIMER)		
(1) Short circuit between applicable timer and fuse.	Operate applicable timer. Observe valve number which appears in timer window as circuit breaker opens. Check electrical wiring between timer and fuse for that particular valve.	Repair or replace electrical wiring.
D. ONE TIMER FAILS TO DIRECT ELECTRICAL POWER TO ANY DEICING VALVE		
(1) Defective timer.	Substitute one timer for the other by physically interchanging. Then repeat timer operation.	Replace timer if defective.

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Possible Causes	Isolation Procedures	Correction
D. ONE TIMER FAILS TO DIRECT ELECTRICAL POWER TO ANY DEICING VALVE (Continued)		
(2) Defective airfoil deicing switch. NOTE: With this condition, and with pneumatic manifold pressurized and both timers turned off, deicing air may be flowing from valves No. 6, 7, and 8.	Check switch for continuity.	Replace switch if defective.
(3) Defective electrical wiring between airfoil deicing switch and applicable timer.	Check electrical wiring for continuity.	Repair or replace wiring.
E. AN AIRFOIL DEICING VALVE OPERATES DURING CYCLING OF ONE TIMER, BUT NOT DURING CYCLING OF OTHER TIMER		
(1) Malfunctioning timer.	Substitute one timer for the other by physically interchanging them. Then repeat timer operation.	Replace timer if defective.
(2) Open circuit between timer and fuse.	Check electrical wiring between timer and fuse of circuit suspected to be faulty.	Repair or replace electrical wiring.

Possible Causes	Isolation Procedure	Correction
F. AN AIRFOIL DEICING VALVE FAILS TO OPERATE DURING CYCLING OF EITHER TIMER; NO LIGHT IN FUSE CAP FOR THIS VALVE		
(1) Open circuit between applicable fuse and terminal strip in aft accessory compartment.	Check for electrical power at terminal strip.	Repair or replace electrical wiring.
(2) Open circuit between terminal strip and ground. NOTE: This would include valve solenoid winding and pigtail which grounds valve to airplane.	Check continuity from terminal strip to ground.	Repair or replace electrical wiring. Replace valve if solenoid winding is open.
(3) Valve stuck closed	(See correction.)	Replace valve.
G. AIRFLOW IS ABSENT FROM VALVE(S), ALTHOUGH BOTH TIMERS HAVE BEEN OPERATED TO POSITION CORRESPONDING TO VALVE(S) IN QUESTION; FUSE CAP LIGHT FOR VALVE(S) IS ON; MANIFOLD IS PRESSURIZED		
(1) Short circuit between fuse input terminal and ground. NOTE: This would include valve solenoid winding and pigtail which grounds valve to airplane.	Stop timers at desired valve position by opening timer motor circuit breakers. Disconnect applicable electrical wires from terminal strip located in accessory compartment. Replace fuse if necessary. Turn on airfoil deicing switch.	If fuse cap light comes on, repair or replace wiring between fuse and terminal strip. If fuse cap light remains out, repair or replace wiring or components as necessary between terminal strip and ground (including valve and pigtail).

Possible Causes	Isolation Procedure	Correction
H. AIRFLOW IS ABSENT FROM ONE VALVE WHICH NORMALLY OPERATES SIMULTANEOUSLY WITH ANOTHER VALVE; OCCURS WITH EITHER TIMER		
(1) Defective electrical wiring between terminal strip and valve electrical connector; defective valve solenoid or pigtail which grounds valve to airplane.	Check for electrical power at valve electrical connector.	If no power present, repair or replace wiring. If power present, repair or replace valve or pigtail as necessary.
I. CONTINUOUS AIRFLOW FROM A VALVE (WITHOUT TIMER OPERATION)		
(1) Wing deicing valve (supplied directly from pneumatic manifold) stuck open.	Inspect valve for evidence of being stuck open (see 30-10-3).	Replace valve if defective.
(2) Defective airfoil deicing switch.	Check switch for continuity.	Replace switch if defective.
J. CONTINUOUS AIRFLOW FROM A VALVE (ONLY DURING TIMER INSTALLATION)		
(1) Valve stuck open in outer wing or in empennage.	Inspect valve for evidence of being stuck open (see 30-10-3)	Replace valve if defective.

	Possible Causes	Isolation Procedure	Correction
K.	**AIR FLOWS FROM OUTER WING BLEED ORIFICES WHEN AIRFOIL DEICING SWITCH TURNED OFF, AND TAIL DUCT VALVE SWITCH PLACED IN NORMAL POSITION**		
(1)	Short circuit in airfoil deicing switch.	Open empennage deicing and warning circuit breaker. Disconnect electrical wire from X2 of outer wing pneumatic duct valve control relay (see 30-00).	If no continuity, replace airfoil deicing switch.
L.	**AIR FLOWS TO EMPENNAGE WHEN AIRFOIL DEICING SWITCH TURNED OFF, AND TAIL DUCT SWITCH PLACED IN NORMAL POSITION**		
(1)	Tail duct valve stuck open.	Check tail duct valve (see 30-10-2).	Replace valve if defective.
M.	**DEICING AIRFLOW ABSENT FROM EMPENNAGE DEICING DUCT**		
(1)	Open empennage deicing and warning circuit breaker.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2)	Tail duct valve stuck closed.	Check tail duct valve (see 30-10-2).	Replace valve if defective.
(3)	Open circuit between tail duct valve and electrical bus.	Check for electrical power at valve electrical connector.	Repair or replace electrical wiring.
(4)	Ruptured flexible duct connector.	Listen for sound of escaping air to locate defective connector.	Replace damaged connector.

Possible Causes	Isolation Procedure	Correction
N. NO AIRFLOW FROM ANY OUTER WING VALVE DURING SYSTEM OPERATION (USING EITHER TIMER)		
(1) Open circuit between tail duct valve switch and ground connection of outer wing pneumatic duct valve control relay.	Check for electrical power between X1, and ground at relay.	Repair or replace electrical wiring; replace relay if defective.
(2) Open circuit between outer wing pneumatic duct valves circuit breaker and terminal strip located in aft accessory compartment.	Check continuity of electrical wiring involved; check for contacts stuck open in outer wing pneumatic duct valve control relay and in scoops anti-icing switch.	Repair or replace electrical wiring; replace defective relay or switch as necessary.
(3) Short circuit between outer wing pneumatic duct valves circuit breaker and ground at either outer wing pneumatic duct shutoff valve, causing above circuit breaker to open.	Disconnect electrical wires at S3-39 terminal strip in aft accessory compartment. Check for continuity back to outer wing pneumatic duct valves circuit breaker. With circuit breaker open, no continuity should exist between electrical wiring and ground. Check for short circuit from terminal strip t ground through applicable outer wing pneumatic duct shutoff valve.	Repair or replace shorted electrical wiring. Replace shorted outer wing pneumatic duct shutoff valve, outer wing pneumatic duct valve control relay, or scoops anti-icing switch, as applicable.

Possible Causes	Isolation Procedure	Correction
O. NO AIRFLOW FROM OUTER WING VALVES OF ONE WING ONLY, DURING SYSTEM OPERATION (USING EITHER TIMER)		
(1) Open circuit between terminal strip located in aft accessory and ground at applicable outer wing pneumatic duct shutoff valve. This would include open and close windings of valve.	Disconnect both applicable electrical wires from terminal strip, and check for continuity through valve windings to ground.	Repair or replace shorted electrical wiring. Replace shorted valve if necessary.
P. AIRFOIL DEICING VALVES OPERATE OUT-OF-SEQUENCE (SYSTEM IN NORMAL-CYCLE)		
(1) Shorted blocking rectifier (rectifier is conducting in reverse direction).	With system turned on, note which valve is operating out of sequence. Locate rectifier which is permitting electrical power to energize valve at incorrect time.	Replace rectifier.
Q. AIRFOIL DEICING SYSTEM OPERATES IN TRIPLE-CYCLE ALTHOUGH TIMER CYCLE SELECTOR KNOBS ARE IN NORMAL-CYCLE POSITION		
(1) Shorted wing slot deicing relay.	Open airfoil deicing valves circuit breaker. Check for desired absence of continuity from D1 to D2 of wing slot deicing relay.	Replace relay if continuity exists.

Possible Causes	Isolation Procedure	Correction
Q. AIRFOIL DEICING SYSTEM OPERATES IN TRIPLE-CYCLE ALTHOUGH TIMER CYCLE SELECTOR KNOBS ARE IN NORMAL-CYCLE POSITION (Continued)		
(2) Shorted landing gear lever limit switch.	Determine if landing gear lever limit switch has stuck closed by pulling landing gear control lever out of detent position (see Chapter 32). Landing-gear-unsafe warning light (s) should come on. CAUTION: ANY FURTHER MOVEMENT OF THE LEVER MAY CAUSE COLLAPSE OF NOSE-GEAR.	Replace limit switch if defective.
R. AIRFOIL DEICING SYSTEM WILL NOT OPERATE IN TRIPLE-CYCLE		
(1) Open circuit breaker.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2) Defective wing slot deicing relay.	Check relay solenoid from X1 to ground for possible lack of continuity due to worn or damaged contacts.	Replace relay if defective.
S. CERTAIN AIRFOIL DEICING VALVES OPERATE OUT-OF SEQUENCE BY OPENING TOO OFTEN (SYSTEM IN TRIPLE-CYCLE)		
(1) Shorted blocking rectifier (rectifier is conducting in reverse direction).	With system turned on, note which valves operate out of sequence. Locate rectifier which is permitting electrical power to energize valves at incorrect time.	Replace rectifier.

Possible Causes	Isolation Procedure	Correction
T. CERTAIN AIRFOIL DEICING VALVES OPERATE OUT-OF-SEQUENCE BY FAILING TO OPEN AT PROPER TIME (SYSTEM IN TRIPLE-CYCLE)		
(1) Open blocking rectifier.	With system turned on, note which valves are failing to operate. Locate rectifier for respective valves.	Replace rectifier.
U. A WING SLOT DEICING VALVE REMAINS OPEN (SYSTEM IN TRIPLE-CYCLE)		
(1) Shorted A1 to A2 contacts in No. 6, No. 7, or No. 8 deicing relay.	Determine which relay is malfunctioning by noting number of valve which remains open.	Replace relay.
V. A WING SLOT DEICING VALVE REMAINS CLOSED (SYSTEM IN TRIPLE-CYCLE)		
(1) Shorted A2 to A3 contacts in No. 6, No. 7, or No. 8 deicing relay.	Determine which relay is malfunctioning by noting number of valve which remains closed.	Replace relay.
(2) Defective valve solenoid.	Determine by noting which valve is not operating properly.	Replace valve.
(3) Defective electrical wiring.	Check continuity of electrical wiring.	Repair or replace wiring.

4. Trouble Shooting Airfoil Deicing System -- Alternate Method

A. Trouble Shooting Airfoil Deicing System

(1) Using wing slot deicing system line checker, trouble shoot airfoil deicing system per instructions accompanying line checker.

NOTE: The line checker is inserted into the airplane system without disturbing the airplane wiring and may also be used to functionally check the airfoil deicing system.

AIRFOIL - TROUBLE SHOOTING

1. General

A. The airfoil deicing timers and applicable system circuit breakers are located in the flight compartment. The airfoil deicing valves are located along the leading edges of the wing and horizontal stabilizer.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Multimeter	260	Simpson	Make voltage and continuity checks.
B	Wing slot Deicing System Line Checker	4767460-501	Douglas Aircraft Company	Alternate trouble shooting method of wing slot deicing system. (See Paragraph 4.)

3. Trouble Shooting Airfoil Deicing System

Possible Causes	Isolation Procedure	Correction
A. AIRFOIL DEICING TIMER WINDOW INDICATES NO TIMER MOTOR OPERATION		
(1) Airfoil deicing timer circuit breaker open.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2) Defective timer.	Substitute one timer for the other by physically interchanging. Then repeat timer operation.	Replace timer if defective.

	Possible Causes	Isolation Procedure	Correction
A.	**AIRFOIL DEICING TIMER WINDOW INDICATES NO TIMER MOTOR OPERATION (Continued)**		
(3)	Defective electrical wiring; defective airfoil deicing switch.	Check continuity of wiring or switch.	Repair or replace electrical wiring; replace switch.
B.	**ALL AIRFOIL DEICING VALVES FAIL TO OPERATE ALTHOUGH BOTH TIMERS FUNCTION PROPERLY**		
(1)	Airfoil deicing valves circuit breaker open.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2)	Left air conditioning system ground control relay failed to deenergize (in flight).	Test airfoil deicing system (see Adjustment/Test).	Replace relay if defective.
(3)	Defective airfoil deicing switch; defective electrical wiring.	Check continuity of switch or wiring.	Replace switch if defective; repair or replace wiring.
C.	**AIRFOIL DEICING VALVES CIRCUIT BREAKER OPENS AS TIMER OPERATES THROUGH CYCLE (MAY OCCUR WITH EITHER TIMER)**		
(1)	Short circuit between applicable timer and fuse.	Operate applicable timer. Observe valve number which appears in timer window as circuit breaker opens. Check electrical wiring between timer and fuse for that particular valve.	Repair or replace electrical wiring.

Possible Causes	Isolation Procedure	Correction
D. ONE TIMER FAILS TO DIRECT ELECTRICAL POWER TO ANY DEICING VALVE		
(1) Defective timer.	Substitute one timer for the other by physically interchanging. Then repeat timer operation.	Replace timer if defective.
(2) Defective airfoil deicing switch. NOTE: With this condition, and with pneumatic manifold pressurized and both timers turned off, deicing air may be flowing from valves No. 6, 7, and 8, and on airplanes 801 - 804, from wing valves 9, 10, 11, and 12.	Check switch for continuity.	Replace switch if defective.
(3) Defective electrical wiring between airfoil deicing switch and applicable timer.	Check electrical wiring for continuity.	Repair or replace wiring.
E. AN AIRFOIL DEICING VALVE OPERATES DURING CYCLING OF ONE TIMER, BUT NOT DURING CYCLING OF OTHER TIMER		
(1) Malfunctioning timer.	Substitute one timer for the other by physically interchanging. Then repeat timer operation.	Replace timer if defective.
(2) Open circuit between timer and fuse.	Check electrical wiring between timer and fuse of circuit suspected to be faulty.	Repair or replace electrical wiring.

	Possible Causes	Isolation Procedure	Correction

F. AN AIRFOIL DEICING VALVE FAILS TO OPERATE DURING CYCLING OF EITHER TIMER; NO LIGHT IN FUSE CAP FOR THIS VALVE

	Possible Causes	Isolation Procedure	Correction
(1)	Open circuit between applicable fuse and terminal strip in aft accessory compartment.	Check for electrical power at terminal strip.	Repair or replace electrical wiring.
(2)	Open circuit between terminal strip and ground. NOTE: This would include valve solenoid winding and pigtail which grounds valve to airplane.	Check continuity from terminal strip to ground.	Repair or replace electrical wiring. Replace valve if solenoid winding is open.
(3)	Valve stuck closed.	(See correction.)	Replace valve.

G. AIRFLOW IS ABSENT FROM VALVE(S), ALTHOUGH BOTH TIMERS HAVE BEEN OPERATED TO POSITION CORRESPONDING TO VALVE(S) IN QUESTION; FUSE CAP LIGHT FOR VALVE(S) IS ON; MANIFOLD IS PRESSURIZED

	Possible Causes	Isolation Procedure	Correction
(1)	Short circuit between fuse input terminal and ground. NOTE: This would include valve solenoid winding and pigtail which grounds valve to airplane.	Stop timers at desired valve position by opening timer motor circuit breakers. Disconnect applicable electrical wires from terminal strip located in accessory compartment. Replace fuse if necessary. Turn on airfoil deicing switch.	If fuse cap light comes on, repair or replace wiring between fuse and terminal strip. If fuse cap light remains out, repair or replace wiring or components as necessary between terminal strip and ground (including valve and pigtail).

Possible Causes	Isolation Procedure	Correction
G. AIRFLOW IS ABSENT FROM VALVE(S), ALTHOUGH BOTH TIMERS HAVE BEEN OPERATED TO POSITION CORRESPONDING TO VALVE(S) IN QUESTION; FUSE CAP LIGHT FOR VALVE(S) IS ON; MANIFOLD IS PRESSURIZED (Continued)		
(2) On airplanes 801-817, defective tail duct valve test switch (involving valve Nos. 2 or 4).	Check continuity of switch in both positions.	Replace switch if defective.
H. AIRFLOW IS ABSENT FROM ONE VALVE WHICH NORMALLY OPERATES SIMULTANEOUSLY WITH ANOTHER VALVE; OCCURS WITH EITHER TIMER		
(1) Defective electrical wiring between terminal strip and valve electrical connector; defective valve solenoid or pigtail which grounds valve to airplane.	Check for electrical power at valve electrical connector.	If no power present, repair or replace wiring. If power present, repair or replace valve or pigtail as necessary.
I. CONTINUOUS AIRFLOW FROM A VALVE (WITHOUT TIMER OPERATION)		
(1) Wing deicing valve (supplied directly from pneumatic manifold) stuck open.	Inspect valve for evidence of being stuck open (see 30-10-3).	Replace valve if defective.
(2) Defective airfoil deicing switch.	Check switch for continuity.	Replace switch if defective.

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	Possible Causes	Isolation Procedure	Correction
J.	**CONTINUOUS AIRFLOW FROM A VALVE (ONLY DURING TIMER OPERATION)**		
(1)	Valve stuck open in outer wing or in empennage.	Inspect valve for evidence of being stuck open (see 30-10-3).	Replace valve if defective.
K.	**AIR FLOWS FROM OUTER WING AND EMPENNAGE BLEED ORIFICES WHEN AIRFOIL DEICING SWITCH TURNED OFF, AND TAIL DUCT VALVE SWITCH, AND TAIL DUCT VALVE TEST SWITCH (801 - 817) PLACED IN NORMAL POSITION**		
(1)	Short circuit in airfoil deicing switch or on airplanes 801 - 817 short in tail duct valve test switch.	Open empennage deicing and warning circuit breaker. Disconnect electrical wire from X2 of outer wing pneumatic duct valve control relay (see 30-00). Check D2 to D3 of tail duct valve test switch.	If no continuity, replace airfoil deicing switch. If continuity exists, disconnect wire from D2 and recheck. If continuity still exists, replace tail duct valve test switch.
L.	**AIR FLOWS FROM EMPENNAGE BLEED ORIFICES WHEN AIRFOIL DEICING SWITCH TURNED OFF, AND TAIL DUCT SWITCH PLACED IN NORMAL POSITION**		
(1)	Tail duct valve stuck open.	Check tail duct valve (see 30-10-2).	Replace valve if defective.
M.	**DEICING AIRFLOW ABSENT FROM ALL EMPENNAGE DEICING VALVES**		
(1)	Open empennage deicing and warning circuit breaker.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2)	Tail duct valve stuck closed.	Check tail duct valve (see 30-10-2).	Replace valve if defective.

Possible Causes	Isolation Procedure	Correction
M. DEICING AIRFLOW ABSENT FROM ALL EMPENNAGE DEICING VALVES (Continued)		
(3) Open circuit between tail duct valve and electrical bus.	Check for electrical power at valve electrical connector.	Repair or replace electrical wiring.
(4) Ruptured flexible duct connector.	Listen for sound of escaping air to locate defective connector.	Replace damaged connector.
N. NO AIRFLOW FROM ANY OUTER WING VALVE OR EMPENNAGE VALVE DURING SYSTEM OPERATION (USING EITHER TIMER)		
(1) Open empennage deicing and warning circuit breaker.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2) Open circuit between empennage deicing and warning circuit breaker and tail duct valve switch.	Check for electrical power at tail duct valve switch input terminal.	Repair or replace electrical wiring.
O. NO AIRFLOW FROM ANY OUTER WING VALVE DURING SYSTEM OPERATION (USING EITHER TIMER)		
(1) Open circuit between tail duct valve switch and ground connection of outer wing pneumatic duct valve control relay.	Check for electrical power between XI and ground at relay.	Repair or replace electrical wiring; replace relay if defective.

	Possible Causes	Isolation Procedure	Correction

O. NO AIRFLOW FROM ANY OUTER WING VALVE DURING SYSTEM OPERATION (USING EITHER TIMER) (Continued)

	Possible Causes	Isolation Procedure	Correction
(2)	Open circuit between outer wing pneumatic duct valves circuit breaker and terminal strip located in aft accessory compartment.	Check continuity of electrical wiring involved; check for contacts stuck open in outer wing pneumatic duct valve control relay and in scoops anti-icing switch.	Repair or replace electrical wiring; replace defective relay or switch as necessary.
(3)	Short circuit between outer wing pneumatic duct valves circuit breaker and ground at either outer wing pneumatic duct shutoff valve, causing above circuit breaker to open.	Disconnect electrical wires at terminal strip in aft accessory compartment. Check for continuity back to outer wing pneumatic duct valves circuit breaker. With circuit breaker open, no continuity should exist between electrical wiring and ground. Check for short circuit from terminal strip to ground through applicable outer wing pneumatic duct shutoff valve.	Repair or replace shorted electrical wiring. Replace shorted outer wing pneumatic duct shutoff valve, outer wing pneumatic duct valve control relay, or scoops anti-icing switch, as applicable.

P. NO AIRFLOW FROM OUTER WING VALVES OF ONE WING ONLY, DURING SYSTEM OPERATION (USING EITHER TIMER)

	Possible Causes	Isolation Procedure	Correction
(1)	Open circuit between terminal strip located in aft accessory and ground at applicable outer wing pneumatic duct shutoff valve. This would include open and close windings of valve.	Disconnect both applicable electrical wires from terminal strip, and check for continuity through valve windings to ground.	Repair or replace shorted electrical wiring. Replace shorted valve if necessary.

	Possible Causes	Isolation Procedure	Correction
Q.	AIRFOIL DEICING VALVES OPERATE OUT-OF-SEQUENCE (SYSTEM IN NORMAL-CYCLE)		
(1)	Shorted blocking rectifier (rectifier is conducting in reverse direction).	With system turned on, note which valve is operating out-of-sequence. Locate rectifier which is permitting electrical power to energize valve at incorrect time.	Replace rectifier.
R.	AIRFOIL DEICING SYSTEM OPERATES IN TRIPLE-CYCLE ALTHOUGH TIMER CYCLE SELECTOR KNOBS ARE IN NORMAL-CYCLE POSITION		
(1)	Shorted wing slot deicing relay.	Open airfoil deicing valves circuit breaker. Check for desired absence of continuity from D1 to D2 of wing slot deicing relay.	Replace relay if continuity exists.
(2)	Shorted landing gear lever limit switch.	Determine if landing gear lever limit switch has stuck closed by pulling landing gear control lever out of detent position (see Chapter 32). Landing-gear-unsafe warning light(s) should come on. CAUTION: ANY FURTHER MOVEMENT OF THE LEVER MAY CAUSE COLLAPSE OF NOSEGEAR.	Replace limit switch if defective.

Possible Causes	Isolation Procedure	Correction
S. AIRFOIL DEICING SYSTEM WILL NOT OPERATE IN TRIPLE-CYCLE		
(1) Open circuit breaker.	Check circuit breaker.	Close circuit breaker unless known to have opened due to faulty circuit.
(2) Defective wing slot deicing relay.	Check relay solenoid from X1 to ground for possible lack of continuity due to worn or damaged contacts.	Replace relay if defective.
T. CERTAIN AIRFOIL DEICING VALVES OPERATE OUT-OF-SEQUENCE BY OPENING TOO OFTEN (SYSTEM IN TRIPLE-CYCLE)		
(1) Shorted blocking rectifier (rectifier is conducting in reverse direction).	With system turned on, note which valves operate out-of-sequence. Locate rectifier which is permitting electrical power to energize valves at incorrect time.	Replace rectifier.
U. CERTAIN AIRFOIL DEICING VALVES OPERATE OUT-OF-SEQUENCE BY FAILING TO OPEN AT PROPER TIME (SYSTEM IN TRIPLE-CYCLE)		
(1) Open blocking rectifier.	With system turned on, note which valves are failing to operate. Locate rectifier for respective valves.	Replace rectifier.
V. A WING SLOT DEICING VALVE REMAINS OPEN (SYSTEM IN TRIPLE-CYCLE)		
(1) Shorted A1 to A2 contacts in No. 6, No. 7, or No. 8 deicing relay.	Determine which relay is malfunctioning by noting number of valve which remains open.	Replace relay.

	Possible Causes	Isolation Procedure	Correction
W.	A WING SLOT DEICING VALVE REMAINS CLOSED (SYSTEM IN TRIPLE-CYCLE)		
(1)	Shorted A2 to A3 contacts in No. 6, No. 7, or No. 8 deicing relay.	Determine which relay is malfunctioning by noting number of valve which remains closed.	Replace relay.
(2)	Defective valve solenoid.	Determine by noting which valve is not operating properly.	Replace valve.
(3)	Defective electrical wiring.	Check continuity of electrical wiring.	Repair or replace wiring.

4. Trouble Shooting Airfoil Deicing System -- Alternate Method

A. Trouble Shooting Airfoil Deicing System

(1) Using wing slot deicing system line checker, trouble shoot airfoil deicing system per instructions accompanying line checker.

NOTE: The line checker is inserted into the airplane system without disturbing the airplane wiring and may also be used to functionally check the airfoil deicing system.

AIRFOIL - ADJUSTMENT/TEST

1. General

This test checks airflow from the deicing valves and compares the amount of airflow in pounds per minute with the established allowable amount.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Air pressure gage (with range of 0 to 60 psi and an accuracy within ±0.6 psi and suitable for connection to test boss on right rain removal duct, located in fuselage nose.)			Measure pressure in airplane pneumatic manifold
B	Pneumatic power ground source (capable of maintaining 38 (±1/2) psig at a flow rate of between 2 and 225 pounds per minute at ambient temperature)			Furnish pneumatic power for deicing valve airflow tests
C	28-volt test light			Voltage tests

3. Adjustment/Test Deicing System Functional

A. Test Deicing System

NOTE: The wing slot doors must be closed during the following test procedures and must be hydraulically loaded to avoid damage to the door seals. The position of the door is controlled by the wing flap control handle (see Steps (2) through (5)).

(1) Make certain that following flight compartment controls and switches are in positions indicated:

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Check that hydraulic system selector control lever is in general system (normal) position (see Chapter 29).

CAUTION: BEFORE PRESSURIZING HYDRAULIC POWER SYSTEM, MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(3) Connect a hydraulic test stand to ground pressure and supply connections (see Chapter 29).

(4) Pressurize hydraulic power system (see Chapter 29).

(5) Place wing flap control handle in up detent.

(6) Open access door 2 (see Chapter 20) and pressurize pneumatic manifold through fuselage nose ground pneumatic connector, and check valve.

<u>NOTE</u>: The pneumatic power required for the test is supplied from a ground source and is maintained at 38 (±2) psi at a temperature not to exceed 93.3°C (200°F). The air supplied to ground pneumatic connector must have a cleanness equivalent to that obtained by using a 10-micron filter and must have a minimum amount of entrained oil and water.

(7) Pull out and turn airfoil deicing timer cycle selector knobs for timer 1 and timer 2 to normal cycle position.

(8) Turn airfoil deicing timer cycle temperature knob for both timers to test position.

(9) Place airfoil deicing switch in timer 1 position. The timer operation should require 23 to 31 seconds for a complete cycle.

(10) Make certain that tail duct valve and outer wing pneumatic duct shutoff valves are open, checking by sound or feel for airflow through left and right horizontal stabilizer tip bleeds.

(11) Place airfoil deicing switch in timer 2 position. The results should be as outlined in steps (9 and 10).

(12) Place irfoil deicing switch in off position. Tail duct valve and outer wing pneumatic duct shutoff valves should close. Check by sound or feel that there is no airflow through left and right horizontal stabilizer tip bleeds.

(13) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of circuit breaker panel.

(14) Open landing gear warning and interlock circuit breaker, located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(15) Connect jumper wire between terminals C2 and C3 of left air conditioning system ground control relay.

(16) Disconnect and cap electrical connector from No. 1 right deicing valve (to reduce required airflow).

(17) Close airfoil deicing valves circuit breaker.

(18) Pull out and turn airfoil deicing timer cycle selector knob for timer 1 to long cycle position.

(19) Turn airfoil deicing timer 1 temperature knob to -5° ram air temperature position.

(20) Place airfoil deicing switch in timer 1 position. Timer required from 4 minutes 21 seconds to 5 minutes 54 seconds for complete cycle. Check by sound or feel that each deicing valve operates in proper sequence (see Figure 501 and 502), with exception of disconnected No. 1 right valve.

NOTE: The wing slot door seals can be checked along wing span areas of seals when appropriate deicing valves are open. There should be no leakage in these areas, but leakage is acceptable at door ends. For closer monitoring of these conditions, timer cycle can be interrupted by opening airfoil deicing timer 1 circuit breaker. This action stops the timer without affecting airflow to selected deicing valves; all interruptions correspondingly lengthen total timer cycle period.

(21) Repeat procedures or steps (18) through (20) for timer 2, except door seal check. Results should be same as in step (26).

(22) Place airfoil deicing switch in off position.

(23) Open airfoil deicing valves circuit breaker.

(24) Place pneumatic crossfeed switch in closed position.

(25) Connect electrical connector to No. 1 right deicing valve.

(26) Place airfoil deicing switch in either timer position and operate timer to position 12.

(27) Close airfoil deicing valve circuit breaker. Check that No. 1 right valve opens and then closes as timer operates through position 1.

(28) Place airfoil deicing switch in off position.

(29) Place pneumatic crossfeed switch in down and guarded position.

(30) Shut off ground air supply, and relieve pneumatic manifold pressure.

NOTE: The procedure in steps (32) through (34) check increased deicing rate circuitry for wing slot areas. Deicing airflow is not used in test because fuselage nose ground pneumatic connector could not handle volume of air required.

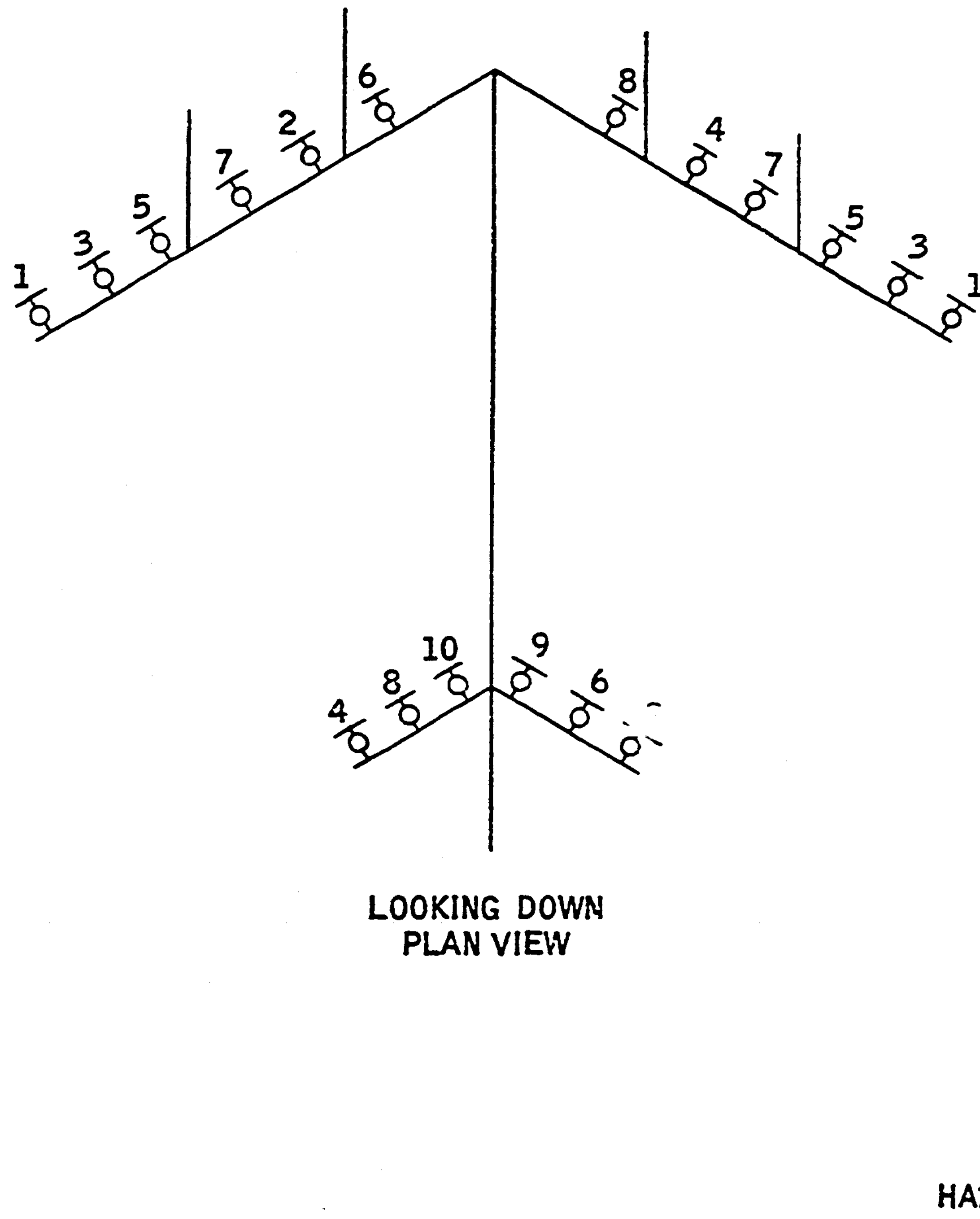
(31) Depressurize hydraulic power system (see Chapter 29).

(32) Close landing gear warning and interlock circuit breaker.

(33) Adjust temperature and cycle selector knobs of either airfoil deicing timer to any convenient rate.

Valve Number	Valve Location	Access Door
1	Outer Wing Outer Wing	518A 518A
2	Center Horizontal Stabilizer	522B 64A
3	Outer Wing Outer Wing	519A 519A
4	Center Wing Horizontal Stabilizer	522B 64A
5	Outer Wing Outer Wing	519C 519C
6	Inner Wing Horizontal Stabilizer	520D 64D
7	Center Wing Center Wing	522A 522A
8	Inner Wing Horizontal Stabilizer	520D 64D
9	Horizontal Stabilizer	64G
10	Horizontal Stabilizer	64G

Airfoil Deicing System Valve Location
Figure 501



Airfoil Deicing System Valve Operating
Sequence -- Schematic
Figure 502

(34) Locate electrical terminal strip on right side of forward bulkhead in accessory compartment.

(35) Place airfoil deicing switch in chosen timer position.

(36) Connect 28-volt test light between nearest convenient ground stud and terminal corresponding to timer position as follows:

CAUTION: TEST AREA MUST BE FREE OF COMBUSTIBLE VAPORS BECAUSE FOLLOWING CHECKS COULD PROVIDE AN ARC.

Timer Position	On terminal strip power should	
	Exist at terminal	Not exist at terminal
1	9	6
2	2	1, 10, 64
3	5	8
4	5	7
5	9	4
6	-	-
7	-	-
8	-	-
9	2	3
10	2	-
11	5	-
12	5	-

NOTE: The chosen timer motor can be stopped at any desired position by opening the applicable deicing timer circuit breaker. The timer resumes the cycle when the circuit breaker is again closed.

(37) Open airfoil deicing valves circuit breaker.

(38) Remove jumper installed on ground control relay between terminals C2 and C3.

(39) Close access door 624 (see Chapter 13).

(40) Close airfoil deicing valves circuit breaker.

(41) Test tail duct valve and tail deicing system indicating light using procedures outlined in 30-10-2.

4. Adjustment/Test Airfoil Deicing System

A. Test Airfoil Deicing System Airflow

(1) Place following controls in the positions indicated:

Control	Position
Starter/ignition switches	Off
Pneumatic shutoff switches	Off
Fire control handles	Normal
Windshield rain removal levers	Off
Engine anti-icing switch	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Cabin compressor switches	Off
Freon compressor switches	Off
Tail duct valve switch	Normal
Pneumatic manifold crossfeed shutoff switch	Down and guarded

NOTE: The wing slot doors may be either open or closed during the following test procedures, but if they are closed they should be hydraulically loaded to avoid damage to the door seals. The position of the doors is controlled by the wing flap control lever (see steps 2 through 5).

(2) Check that hydraulic system selector control lever is in general system (normal) position.

(3) Connect hydraulic test stand to ground pressure and supply connections (see Chapter 29).

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(4) Pressurize hydraulic power system (see Chapter 29).

CAUTION: BEFORE PRESSURIZING HYDRAULIC POWER SYSTEM, MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(5) Place wing flap handle in up detent.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT AREAS AROUND LEFT AND RIGHT FLAPS AND WING SLOTS ARE CLEAR OF PERSONNEL AND EQUIPMENT.

(6) Connect air pressure gage to test boss located on bottom of right rain removal duct next to low-pressure pneumatic manifold crossfeed shutoff valve.

(7) Connect pneumatic power ground source and pressurize airplane pneumatic manifold to 38 (±1/2) psig at ambient temperature (see Chapter 36).

NOTE: Manifold pressure should be maintained at 38 (±1/2) psig at ambient temperature under all conditions of airflow. It is more convenient to monitor manifold pressure by this gage than by manifold pressure in flight compartment.

(8) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of EPC circuit breaker panel.

(9) Disconnect and cap electrical connector from No. 1 right deicing valve to reduce volume of air required for test.

(10) Close airfoil deicing valves circuit breaker.

(11) Place airfoil deicing switch in timer 1 position. Check by sound or feel for airflow at left and right horizontal stabilizer tip bleeds.

(12) When airflow stabilizes, measure and record flow in column 1 on applicable flow chart.

(13) Open airfoil deicing timer 1 circuit breaker, located on heat, vent and ice protection (ac bus) section of EPC circuit breaker panel. Timer 1 should stop.

(14) Open landing gear warning and interlock circuit breaker, located on miscellaneous (dc bus) section of the circuit breaker panel.

(15) Open the airfoil deicing valves circuit breaker, located on the heat, vent and ice protection (dc bus) section of circuit breaker panel.

(16) Locate left air conditioning system ground control relay. Connect a jumper wire between terminals C2 and C3.

(17) Close airfoil deicing valves circuit breaker.

(18) Check timer window to determine which two deicing valves are selected.

(19) Check that two indicated deicing valves are open (except No. 1R in right wing). Check by sound or feel for airflow in areas listed on deicing sequence chart (see Figure 501) and in Figure 502.

(20) Measure and record airflow in column 2 on flow chart (see Figure 503).

(21) Compute measurement for column 3 and compare with allowable range listed in column 4 of flow chart.

(22) Close airfoil deicing timer 1 circuit breaker. When timer window indicates that deicing system is in next sequence, open circuit breaker.

(23) Check that two deicing valves that were open in step (19) are now closed, and that two deicing valves now indicated by timer window are open (with exception of No. 1R). Check by sound or feel for airflow in areas listed on deicing sequence chart and in Figure 502.

(24) Measure and record airflow in column 2 on flow chart.

(25) Compute measurement for column 3 and compare with allowable range listed in column 4 of flow chart.

(26) Repeat steps (20) through (25) until flow has been measured and recorded for timer positions 1 through 10.

(27) Check valves and connections corresponding to timer positions 6, 7L and 8 by sound or feel for leakage at duct connections to wing leading edge slot lower doors.

(28) Check for leakage at seals between slot vanes and lower doors.

NOTE: No leakage is permissible in the spanwise areas of seals. Moderate leakage is permissible at door ends.

(29) Check duct connections which correspond to timer positions 6, 7 and 8 by listening or feeling for leakage at inner and center wing duct connectors.

(30) Open airfoil deicing valves circuit breaker.

(31) Place the pneumatic crossfeed switch in closed position.

(32) Check that no airflow exists at left and right horizontal stabilizer tip bleeds.

(33) Remove caps and connect electrical connector to No. 1R deicing valve.

(34) Close airfoil deicing valves circuit breaker.

	1	2	3	4	
Deicing Valves	Measured Flow (lb/min)	Measured Flow (lb/min)	Deicing Valve Flow -- Column 2 less Column 1 (lb/min)	Allowable Flow (lb/min) Min.	Max.
1L				83	96
2				140	161
3				146	167
4				140	161
5				140	162
6				60	69
7				133	153
8				60	70
9				33	39
10				35	41
1R				83	96

O.A.T. = ____________ °F

Test air: Temp. ____________ °F

Press. ____________ psi

Flow Chart
Figure 503

(35) Close airflow deicing timer 1 circuit breaker and reopen when 1R appears in timer window.

(36) Check by sound or feel that No. 1R deicing valve is open.

(37) Check for leakage for 7R at seal between slot vane and lower door as applicable.

(38) Measure and record airflow in column 2 on flow chart.

(39) Open airfoil deicing valves circuit breaker.

(40) Check by sound or feel that No. 1R deicing valve is closed.

(41) Record remaining airflow.

(42) Compute measurement for column 3 by subtracting value in step (41) from step (36) and compare difference with allowable range listed in column 4 of flow chart.

(43) Place airfoil deicing switch in off position.

(44) Close airfoil deicing timer 1 circuit breaker.

(45) Remove jumper wire connected between terminals C2 and C3 of air-conditioning ground control relay.

(46) Close airfoil deicing valves circuit breaker.

(47) Close landing gear warning and interlock circuit breakers.

(48) Depressurize pneumatic manifold and disconnect ground pneumatic source from fuselage nose ground pneumatic connector.

(49) Place pneumatic crossfeed switch in down and guarded position.

(50) Check fail-safe indicator band of all flexible, double-wall duct connectors in tail deicing supply duct in pressurized area of fuselage.

(51) Check all deicing valve hose connections for general condition.

(52) Depressurize hydraulic power system (see Chapter 29).

(53) Disconnect hydraulic test stand from ground pressure and supply connections (see Chapter 29).

5. Adjustment/Test Double-Wall Duct Connectors

A. Test Connectors For Leakage

(1) Pressurize pneumatic manifold through ground pneumatic connection with a pressure of 28 (±0.5) psi ambient temperature (see Chapter 36).

(2) Place airfoil deicing switch in either timer position.

(3) Check connector for no leakage by feel and sound.

(4) Increase pressure to 38 (±0.5) psi and hold for minimum of 2 minutes.

(5) Relieve pressure in duct by placing airfoil deicing switch in off position.

(6) Check connector fail-safe indicator band for general condition and tripped indication.

(7) Depressurize pneumatic manifold and disconnect ground pneumatic source (see Chapter 36).

AIRFOIL - ADJUSTMENT/TEST

1. General

   A. This test checks airflow from the deicing valves and compares the amount of airflow in pounds per minute with the established allowable amount.

2. Tools and Equipment Required

   NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Air pressure gage (with range of 0 to 60 psi and an accuracy within ±0.6 psi and suitable for connection to test boss on right rain removal duct, located in fuselage nose.)			Measure pressure in airplane pneumatic manifold
B	Pneumatic power ground source (capable of maintaining 38 (±2) psig at a flow rate of between 2 and 225 pounds per minute at ambient temperature)			Furnish pneumatic power for deicing valve airflow tests
C	28-volt test light			Voltage tests

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3. Adjustment/Test Deicing System Functional

A. Test Deicing System

NOTE: The wing slot doors must be closed during the following test procedures and must be hydraulically loaded to avoid damage to the door seals. The position of the door is controlled by the wing flap control handle (see steps (2) through (5)).

(1) Make certain that following flight compartment controls and switches are in positions indicated:

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Check that hydraulic system selector control lever is in general system (normal) position (see Chapter 29).

CAUTION: BEFORE PRESSURIZING HYDRAULIC POWER SYSTEM, MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(3) Connect a hydraulic test stand to ground pressure and supply connections (see Chapter 29).

(4) Pressurize hydraulic power system (see Chapter 29).

(5) Place wing flap control handle in up detent.

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(6) Pressurize pneumatic manufold through pneumatic ground connector. (See Chapter 36).

NOTE: The pneumatic power required for the test is supplied from a ground source and is maintained at 38 (±2) psi at a temperature not to exceed 93.3°C (200°F). The air supplied to ground pneumatic connector must have a cleanness equivalent to that obtained by using a 10-micron filter and must have a minimum amount of entrained oil and water.

(7) Pull out and turn airfoil deicing timer cycle selector knobs for timer 1 and timer 2 to normal cycle position.

(8) Turn airfoil deicing timer cycle temperature knob for both timers to test position.

(9) Place airfoil deicing switch in timer 1 position. Timer operation should require 23 to 31 seconds for complete cycle.

(10) Make certain that tail duct valve is closed and outer wing pneumatic duct shutoff valves are open.

(11) Place airfoil deicing switch in timer 2 position. Results should be as outlined in steps (9 and 10).

(12) Place airfoil deicing switch in off position. Outer wing pneumatic duct shutoff valves should close. Check by sound or feel that there is no airflow.

(13) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of circuit breaker panel.

(14) Open lift and right ground control relay circuit breakers located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(15) Disconnect and cap electrical connector from No. 6 right deicing valve (to reduc required airflow).

(16) Close airfoil deicing valves circuit breaker.

(17) Pull out and turn airfoil deicing timer cycle selector knob for timer 1 to long cycle position.

(18) Turn airfoil deicing timer 1 temperature knob to -5° ram air temperature position.

(19) Place airfoil deicing switch in timer 1 position. Timer requires from 4 minutes 21 seconds to 5 minutes 54 seconds for complete cycle. Check by sound or feel that each deicing valve operates in proper sequence (see Figure 501 and 502), with exception of disconnected No. 6 right valve.

NOTE: The wing slot door seals can be checked along wing span areas of seals when appropriate deicing valves are open. There should be no leakage in these areas, but leakage is acceptable at door ends. For closer monitoring of these conditions, timer cycle can be interrupted by opening airfoil deicing timer 1 circuit breaker. This action stops the timer without affecting airflow to selected deicing valves; all interruptions correspondingly lengthen total timer cycle period.

(20) Repeat steps (17) through (19) for timer 2 except door seal check. Results should be same as in step (19).

(21) Place airfoil deicing switch in timer 1 position.

(22) Make certain tail duct valve switch is in normal position.

(23) Press tail deice pushbutton switch. Check following.

(a) Tail duct valve should open and air should flow to horizontal stablizer for 150(±15) seconds.

(b) Timer will stop and there should be no air flow to wing leading edge during cycle period.

NOTE: If pushbutton is reactuated during any part of a preceding cycle, a new cycle will begin. The tail deice system warning light will come on momentarily during initial opening of tail duct valve.

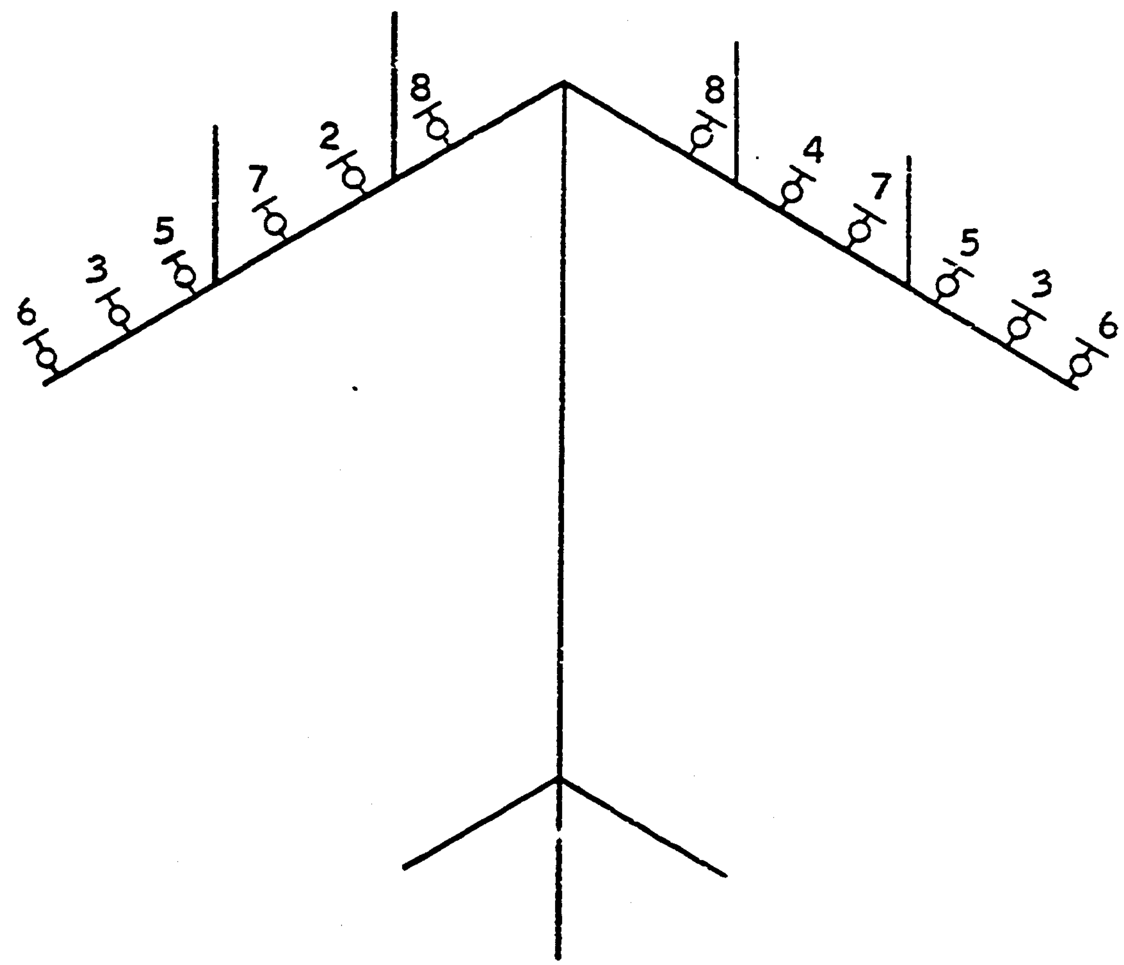
(24) Place airfoil deice switch in timer 2 position.

(25) Repeat step (23).

(26) Place airfoil deicing switch in off position.

Valve Number	Valve Location	Access Door
2	Center	522B
3	Outer Wing Outer Wing	519A 519A
4	Center Wing	522B

Airfoil Deicing System Valve Location
Figure 501 (Sheet 1)



LOOKING DOWN
PLAN VIEW

HA2-2721

Airfoil Deicing System Valve Operating
Sequence -- Schematic
Figure 502

Valve Number	Valve Location	Access Door
5	Outer Wing Outer Wing	519C 519C
6	Outer Wing Outer Wing	518A 518A
7	Center Wing Center Wing	522A 522A
8	Inner Wing Inner Wing	520D 520D

Airfoil Deicing System Valve Location
Figure 501 (Sheet 2)

(27) Open airfoil deicing valves circuit breaker.

(28) Place pneumatic crossfeed switch in closed position.

(29) Connect electrical connector to No. 6 right deicing valve.

(30) Place airfoil deicing switch in either timer position and operate timer to position 5.

(31) Close airfoil deicing valve circuit breaker. Check that No. 6 right valve opens and then closes as timer operates through position 6.

(32) Place airfoil deicing switch in off position.

(33) Place pneumatic crossfeed switch in down and guarded position.

(34) Shut off ground air supply, and relieve pneumatic manifold pressure (see Chapter 36).

(35) Depressurize hydraulic power system (see Chapter 29).

NOTE: The procedure in steps 36 and 37 check increased deicing rate circuitry for wing slot areas. Deicing airflow is not used in test because fuselage nose ground pneumatic connector could not handle volume of air required.

(36) Adjust temperature and cycle selector knobs of either airfoil deicing timer to any convenient rate.

(37) Locate electrical terminal strip on right side of forward bulkhead in accessory compartment.

(38) Place airfoil deicing switch in chosen timer position.

(39) Connect 28-volt test light between nearest convenient ground stud and terminal corresponding to timer position as follows:

<u>CAUTION</u>: ACCESSORY COMPARTMENT MUST BE FREE OF COMBUSTIBLE VAPORS BECAUSE FOLLOWING VOLTAGE CHECKS COULD PROVIDE AN ARC.

Timer Position	On terminal strip power should	
	Exist at terminal	Not exist at terminal
6	-	-
2	5	7
3	5	3
4	9	-
5	-	-
8	-	-
7	-	-
8	-	-
9	-	-
10	5	3, 7
11	5	3, 7
12	9	8

<u>NOTE</u>: The chosen timer motor can be stopped at any desired position by opening the applicable deicing timer circuit breaker. The timer resumes the cycle when the circuit breaker is again closed.

(40) Close left and right ground control relay circuit breakers.

(41) Close access door 624 (see Chapter 20).

4. Adjustment/Test Airfoil Deicing System Airflow

A. Test Airfoil Deicing System Airflow

(1) Place following controls in positions indicated:

Control	Position
Starter/ignition switches	Off
Pneumatic shutoff switches	Off
Fire control handles	Normal
Windshield rain removal levers	Off
Engine anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Cabin compressor switches	Off
Freon compressor switches	Off
Tail duct valve switch	Normal
Pneumatic manifold crossfeed shutoff switch	Down and guarded

NOTE: The wing slot doors may be either open or closed during the following test procedures, but if they are closed they should be hydraulically loaded to avoid damage to the door seals. The position of the doors is controlled by the wing flap control lever (see steps 2 through 5).

(2) Check that hydraulic system selector control lever is in general system (normal) position.

(3) Connect hydraulic test stand to ground pressure and supply connections (see Chapter 29).

(4) Pressurize hydraulic power system (see Chapter 29).

CAUTION: BEFORE PRESSURIZING HYDRAULIC POWER SYSTEM, MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(5) Place wing flap handle in up detent.

<u>WARNING</u>: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT AREAS AROUND LEFT AND RIGHT FLAPS AND WING SLOTS ARE CLEAR OF PERSONNEL AND EQUIPMENT.

(6) Connect air pressure gage to test boss located on bottom of right rain removal duct next to low-pressure pneumatic manifold crossfeed shutoff valve.

(7) Connect pneumatic power ground source and pressurize airplane pneumatic manifold to 38 (±2) psig at ambient timperature (see Chapter 36).

<u>NOTE</u>: Mainfold pressure should be maintained at 38 (±2) psig at ambient temperature under all conditions of airflow. It is more convenient to monitor manifold pressure by this gage than by manifold pressure in flight compartment.

(8) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of EPC circuit breaker panel.

(9) Disconnect and cap electrical connector from No. 6 right deicing valve to reduce volume of air required for test.

(10) Close airfoil deicing valves circuit breaker.

(11) Place airfoil deicing switch in timer 1 position. Check by sound or feel for airflow at left and right wing tip bleeds.

(12) When airflow stabilizes, measure and record flow in column 1 on flow chart (see Figure 503).

(13) Open airfoil deicing timer 1 circuit breaker, located on heat, vent and ice protection (ac bus) section of EPC circuit breaker panel. Timer 1 should stop.

(14) Open landing gear warning and interlock circuit breaker, located on miscellaneous (dc bus) section of circuit breaker panel.

(15) Open left and right ground control relay circuit breakers located on miscellaneous (dc bus) section of EPC circuit breaker panel.

<u>WARNING</u>: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(16) Check timer window to determine which two deicing valves are selected.

(17) Check that two indicated deicing valves are open (except No. 6R in right wing). Check by sound or feel for airflow in area of corresponding deicing valve (see Figures 501 and 502).

(18) Measure and record airflow in column 2 on flow chart (see Figure 503).

(19) Compute measurement for column 3 and compare with allowable range listed in column 4 of flow chart.

(20) Close airfoil deicing timer 1 circuit breaker. When timer window indicates that deicing system is in next sequence, open circuit breaker.

(21) Check that two deicing valves that were open in step (17) are now closed, and that two deicing valves now indicated by timer window are open (with exception of No. 6). Check by sound or feel for airflow in areas listed on deicing sequence chart and in Figure 502.

(22) Measure and record airflow in column 2 on flow chart.

(23) Compute measurement for column 3 and compare with allowable range listed in column 4 of flow chart.

(24) Repeat steps (18) through (23) until flow has been measured and recorded for all timer positions.

(25) Check valves and connections corresponding to timer positions 7, 8 and 8 by sound or feel for leakage at duct connections to wing leading edge slot lower doors.

(26) Check for leakage at seals between slot vanes and lower doors.

NOTE: No leakage is permissible in the spanwise areas of seals. Moderate leakage is permissible at door ends.

(27) Check duct connections which correspond to timer positions 7, 8 and 8 by listening or feeling for leakage at inner and center wind duct connectors.

(28) Open airfoil deicing valves circuit breaker.

(29) Connect electrical connector to No. 6R deicing valve.

(30) Close airfoil deicing valves circuit breaker.

(31) Close airflow deicing timer 1 circuit breaker and reopen when 6 appears in timer window.

(32) Check by sound or feel that No. 6 deicing valve is open.

(33) Check for leakage for 7 at seal between slot vane and lower door as applicable.

(34) Measure and record airflow in column 2 on flow chart.

(35) Open airfoil deicing valves circuit breaker.

	1	2	3	4	
Deicing Valves	Measured Flow (lb/min)	Measured Flow (lb/min)	Deicing Valve Flow -- Column 2 less Column 1 (lb/min)	Allowable Flow (lb/min) Min.	Max.
2				140	161
3				146	167
4				140	161
5				140	162
6L				83	96
6R				83	96
7				133	153
8L				60	69
8R				60	70

O.A.T. = ____________ °F

Test air: Temp.____________ °F

Press. ______________________ psi

Flow Chart
Figure 503

(36) Check by sound or feel that No. 6R deicing valve is closed.

(37) Record remaining airflow.

(38) Compute measurement for column 3 by subtracting value in step (37) from step (34) and compare difference with allowable range listed in column 4 of flow chart.

(39) Close airfoil deicing timer 1 circuit breaker.

(40) Push tail deice pushbutton. Record airflow. Airflow should be 137 to 152 pounds per minute.

(41) Close left and right ground control relay circuit breakers located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(42) Close airfoil deicing valves circuit breaker.

(43) Close landing gear warning and interlock circuit breakers.

(44) Place pneumatic crossfeed switch in down and guarded position.

(45) Depressurize pneumatic manifold and disconnect ground pneumatic source from fuselage hose ground pneumatic connector (see Chapter 36).

(46) Depressurize hydraulic power system (see Chapter 29).

(47) Disconnect hydraulic test stand from ground pressure and supply connections (see Chapter 29).

5. Adjustment/Test Double-Wall Duct Connectors

A. Test Connectors for Leakage

(1) Pressurize pneumatic manifold through ground pneumatic connection with a pressure of 28 (±2) psi ambient temperature (see Chapter 36).

(2) Place airfoil deicing switch in either timer position.

(3) Check connectors for no leakage by feel and sound.

(4) Increase pressure to 38 (±2) psi and hold for minimum of 2 minutes.

(5) Relieve pressure in deicing duct by placing airfoil deicing switch in off position.

(6) Check fail-safe indicator band of all flexible, double-wall duct connectors for general condition and tripped indication.

(7) Depressurize pneumatic manifold and disconnect ground pneumatic source (see Chapter 36).

AIRFOIL - ADJUSTMENT/TEST

1. General

   A. This test checks airflow from the deicing valves and compares the amount of airflow in pounds per minute with the established allowable amount.

2. Tools and Equipment Required

   NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Air pressure gage (with range of 0 to 60 psi and an accuracy within ±0.6 psi and suitable for connection to test boss on right rain removal duct, located in fuselage nose)			Measure pressure in airplane pneumatic manifold
B	Pneumatic power ground source (capable of maintaining 38 (±2) psig at a flow rate of between 2 and 225 pounds per minute at ambient temperature)			Furnish pneumatic power for deicing valve airflow tests
C	28-volt test light			Voltage tests

3. Adjustment/Test Deicing System Functional

A. Test Deicing System

NOTE: The wing slot doors must be closed during the following test procedures and must by hydraulically loaded to avoid damage to the door seals. The position of the door is controlled by the wing flap control handle (see steps 2 through 5).

(1) Make certain that following flight compartment controls and switches are in positions indicated:

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Check that hydraulic system selector control lever is in general system (normal) position (see Chapter 29).

CAUTION: BEFORE PRESSURIZING HYDRAULIC POWER SYSTEM, MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(3) Connect a hydraulic test stand to ground pressure and supply connections (see Chapter 29).

(4) Pressurize hydraulic power system (see Chapter 29).

(5) Place wing flap control handle in up detent.

(6) Pressurize pneumatic manifold through pneumatic ground connector.

NOTE: The pneumatic power required for the test is supplied from a ground source and is maintained at 38 (±2) psi at a temperature not to exceed 93.3°C (200°F). The air supplied to ground pneumatic connector must have a cleanness equivalent to that obtained by using a 10-micron filter and must have a minimum amount of entrained oil and water.

(7) Pull out and turn airfoil deicing timer cycle selector knobs for timer 1 and timer 2 to normal cycle position.

(8) Turn airfoil deicing timer cycle temperature knob for both timers to test position.

(9) Place airfoil deicing switch in timer 1 position. Timer operation should require 23 to 31 seconds for complete cycle.

(10) Make certain that tail duct valve is closed and outer wing pneumatic duct shutoff valves are open.

(11) Place airfoil deicing switch in timer 2 position. Results should be as outlined in steps (9 and 10).

(12) Place airfoil deicing switch in off position. Outer wing pneumatic duct shutoff valves should close. Check by sound or feel that there is no airflow.

(13) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of circuit breaker panel.

(14) Open left and right ground control relay circuit breakers located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(15) Disconnect and cap electrical connector from No. 6 right deicing valve (to reduce required airflow).

(16) Close airfoil deicing valves circuit breaker.

(17) Pull out and turn airfoil deicing timer cycle selector knob for timer 1 to long cycle position.

(18) Turn airfoil deicing timer 1 temperature knob to -5° ram air temperature position.

(19) Place airfoil deicing switch in timer 1 position. Timer requires from 4 minutes 21 seconds to 5 minutes 54 seconds for complete cycle. Check by sound or feel that each deicing valve operates in proper sequence (see Figure 501 and 502), with exception of disconnected No. 6 right valve.

NOTE: The wing slot door seals can be checked along wing span areas of seals when appropriate deicing valves are open. There should be no leakage in these areas, but leakage is acceptable at door ends. For closer monitoring of these conditions, timer cycle can be interrupted by opening airfoil deicing timer 1 circuit breaker. This action stops the timer without affecting airflow to selected deicing valves; all interruptions correspondingly lengthen total timer cycle period.

(20) Repeat procedures or steps (17) through (19) for timer 2 except door seal check. Results should be same as in step (19).

(21) Place airfoil deicing switch in timer 1 position.

(22) Make certain tail duct valve switch is in normal position.

(23) Press tail deice pushbutton switch. Check following:

(a) Tail duct valve should open and air should flow to horizontal stabilizer for 150(±15) seconds.

(b) Timer will stop and there should be no air flow to wing leading edge during cycle period.

NOTE: If pushbutton is reactuated during any part of a preceding cycle, a new cycle will begin. The tail deice system warning light will come on momentarily during initial opening of tail duct valve.

(24) Place airfoil deice switch in timer 2 position.

(25) Repeat step (23).

(26) Place airfoil deicing switch in off position.

Valve Number	Valve Location	Access Door
2	Center	522B
3	Outer Wing Outer Wing	519A 519A
4	Center Wing	522B

Airfoil Deicing System Valve Location
Figure 501 (Sheet 1)

Valve Number	Valve Location	Access Door
5	Outer Wing Outer Wing	519C 519C
6	Outer Wing Outer Wing	518A 518A
7	Center Wing Center Wing	522A 522A
8	Inner Wing Inner Wing	520D 520D

Airfoil Deicing System Valve Location
Figure 501 (Sheet 2)

(27) Open airfoil deicing valves circuit breaker.

(28) Place pneumatic crossfeed switch in closed position.

(29) Connect electrical connector to No. 6 right deicing valve.

(30) Place airfoil deicing switch in either timer position and operate timer to position 5.

(31) Close airfoil deicing valve circuit breaker. Check that No. 6 right valve opens and then closes as timer operates through position 6.

(32) Place airfoil deicing switch in off position.

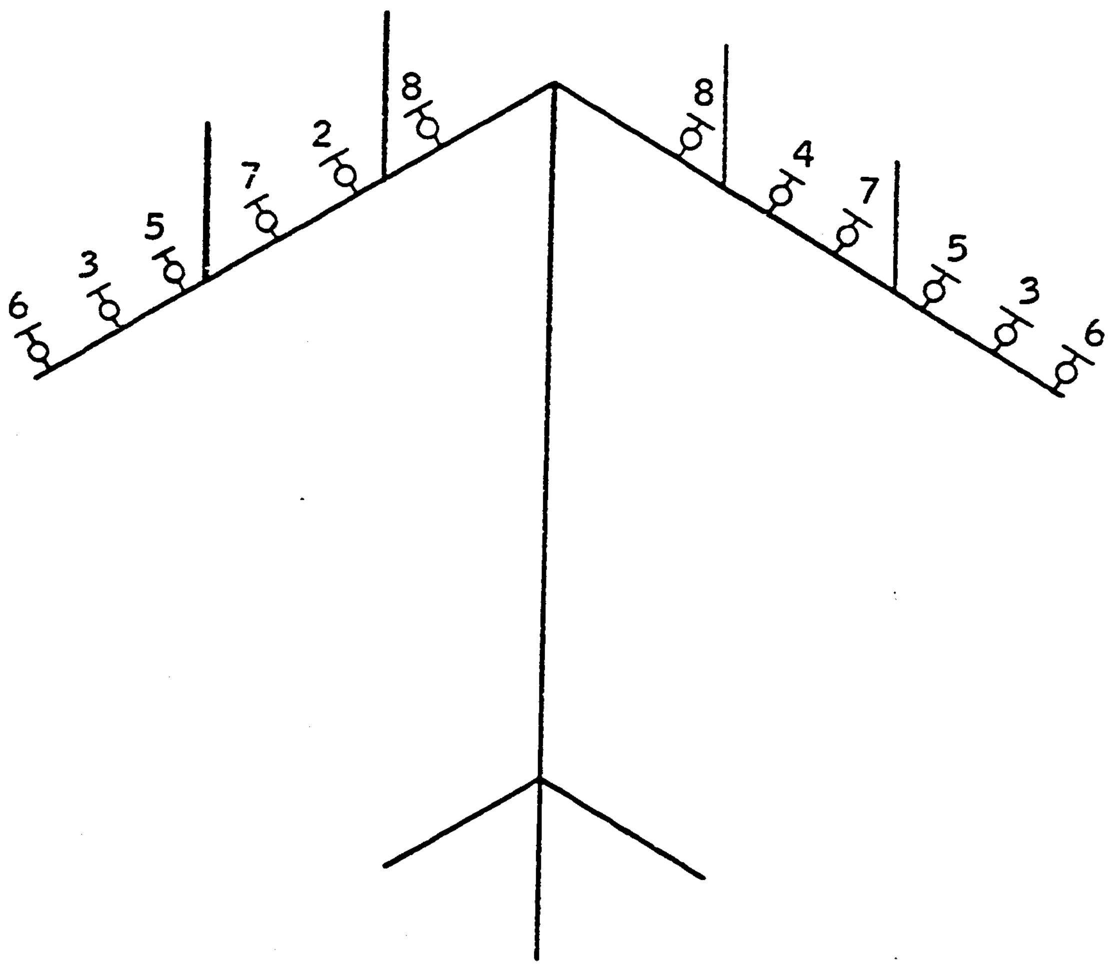
(33) Place pneumatic crossfeed switch in down and guarded position.

(34) Shut off ground air supply, and relieve pneumatic manifold pressure.

(35) Depressurize hydraulic power system (see Chapter 29).

NOTE: The procedure in steps (36) and (37) check increased deicing rate circuitry for wing slot areas. Deicing airflow is not used in test because fuselage nose ground pneumatic connector could not handle volume of air required.

(36) Adjust temperature and cycle selector knobs of either airfoil deicing timer to any convenient rate.



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Airfoil Deicing System Valve Operating
Sequence -- Schematic
Figure 502

(37) Locate burndy block on right side of forward bulkhead in accessory compartment.

(38) Place airfoil deicing switch in chosen timer position.

(39) Connect 28-volt test light between nearest convenient ground stud and terminal corresponding to timer position as follows:

CAUTION: TEST AREA MUST BE FREE OF COMBUSTIBLE VAPORS BECAUSE FOLLOWING CHECKS COULD PROVIDE AN ARC.

Timer Position	On burndy block power should	
	Exist at terminal	Not exist at terminal
6	-	-
2	50	49
3	50	58X
4	51	-
5	-	-
8	-	-
7	-	-
8	-	-
9	-	-
10	50	49, 58X
11	50	49, 58X
12	51	58A

NOTE: The chosen timer motor can be stopped at any desired position by opening the applicable deicing timer circuit breaker. The timer resumes the cycle when the circuit breaker is again closed.

(40) Close left and right ground control relay circuit breakers.

4. Adjustment/Test Airfoil Deicing System Airflow

A. Test Airfoil Deicing System Airflow

(1) Place following controls in the positions indicated:

Control	Position
Starter/ignition switches	Off
Pneumatic shutoff switches	Off
Fire control handles	Normal
Windshield rain removal levers	Off
Engine anti-icing switch	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Cabin compressor switches	Off
Freon compressor switches	Off
Tail duct valve switch	Normal
Pneumatic manifold crossfeed shutoff switch	Down and guarded

NOTE: The wing slot doors may be either open or closed during the following test procedures, but if they are closed they should be hydraulically loaded to avoid damage to the door seals. The position of the doors is controlled by the wing flap control lever (see steps 2 through 5).

(2) Check that hydraulic system selector control lever is in general system (normal) position.

(3) Connect hydraulic test stand to ground pressure and supply connections (see Chapter 29).

(4) Pressurize hydraulic power system (see Chapter 29).

CAUTION: BEFORE PRESSURIZING HYDRAULIC POWER SYSTEM, MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(5) Place wing flap handle in up detent.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT AREAS AROUND LEFT AND RIGHT FLAPS AND WING SLOTS ARE CLEAR OF PERSONNEL AND EQUIPMENT.

(6) Connect air pressure gage to test boss located on bottom of right rain removal duct next to low-pressure pneumatic manifold crossfeed shutoff valve.

(7) Connect pneumatic power ground source and pressurize airplane pneumatic manifold to 38 (±2) psig at ambient temperature (see Chapter 36).

NOTE: Manifold pressure should be maintained at 38 (±2) psig at ambient temperature under all conditions of airflow. It is more convenient to monitor manifold pressure by this gage than by manifold pressure in flight compartment.

(8) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of EPC circuit breaker panel.

(9) Disconnect and cap electrical connector from No. 6 right deicing valve to reduce volume of air required for test.

(10) Close airfoil deicing valves circuit breaker.

(11) Place airfoil deicing switch in timer 1 position. Check by sound or feel for airflow at left and right wing tip bleeds.

(12) When airflow stabilizes, measure and record flow in column 1 on flow chart (see Figure 503).

(13) Open airfoil deicing timer 1 circuit breaker, located on heat, vent and ice protection (ac bus) section of EPC circuit breaker panel. Timer 1 should stop.

(14) Open landing gear warning and interlock circuit breaker, located on miscellaneous (dc bus) section of circuit breaker panel.

(15) Open left and right ground control relay circuit breakers located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(16) Check timer window to determine which two deicing valves are selected.

(17) Check that two indicated deicing valves are open (except No. 6R in right wing). Check by sound or feel for airflow in area of corresponding deicing valve (see Figures 501 and 502).

(18) Measure and record airflow in column 2 on flow chart (see Figure 503).

(19) Compute measurement for column 3 and compare with allowable range listed in column 4 of flow chart.

(20) Close airfoil deicing timer 1 circuit breaker. When timer window indicates that deicing system is in next sequence, open circuit breaker.

(21) Check that two deicing valves that were open in step (17) are now closed, and that two deicing valves now indicated by timer window are open (with exception of No. 6R). Check by sound or feel for airflow in areas listed on deicing sequence chart and in Figure 502.

(22) Measure and record airflow in column 2 on flow chart.

(23) Compute measurement for column 3 and compare with allowable range listed in column 4 of flow chart.

(24) Repeat steps (18 through 23) until flow has been measured and recorded for all timer positions.

(25) Check valves and connections corresponding to timer positions 7, 8 and 8 by sound or feel for leakage at duct connections to wing leading edge slot lower doors.

(26) Check for leakage at seals between slot vanes and lower doors.

NOTE: No leakage is permissible in the spanwise areas of seals. Moderate leakage is permissible at door ends.

(27) Check duct connections which correspond to timer positions 7, 8 and 8 by listening or feeling for leakage at inner and center wing duct connectors.

(28) Open airfoil deicing valves circuit breaker.

(29) Connect electrical connector to No. 6R deicing valve.

(30) Close airfoil deicing valves circuit breaker.

(31) Close airflow deicing timer 1 circuit breaker and reopen when 6 appears in timer window.

(32) Check by sound or feel that No. 6R deicing valve is open.

(33) Check for leakage for 7 at seal between slot vane and lower door as applicable.

(34) Measure and record airflow in column 2 on flow chart.

(35) Open airfoil deicing valves circuit breaker.

	1	2	3	4	
Deicing Valves	Measured Flow (lb/min)	Measured Flow (lb/min)	Deicing Valve Flow -- Column 2 less Column 1 (lb/min)	Allowable Flow (lb/min) Min.	Max.
2				140	161
3				146	167
4				140	161
5				140	162
6L				83	96
6R				83	96
7				133	153
8L				60	69
8R				60	70
O.A.T. = ________ °F			Test air: Temp. ________ °F Press. ________ psi		

Flow Chart
Figure 503

(36) Check by sound or feel that No. 6R deicing valve is closed.

(37) Record remaining airflow.

(38) Compute measurement for column 3 by subtracting value in step (37) from step (34) and compare difference with allowable range listed in column 4 of flow chart.

(39) Close airfoil deicing timer 1 circuit breaker.

(40) Push tail deice pushbutton. Record airflow. Airflow should be 137 to 152 pounds per minute.

(41) Close left and right ground control relay circuit breakers located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(42) Close airfoil deicing valves circuit breaker.

(43) Close landing gear warning and interlock circuit breakers.

(44) Place pneumatic crossfeed switch in down and guarded position.

(45) Depressurize pneumatic manifold and disconnect ground pneumatic source from fuselage nose ground pneumatic connector (see Chapter 36).

(46) Depressurize hydraulic power system (see Chapter 29).

(47) Disconnect hydraulic test stand from ground pressure and supply connections (see Chapter 29).

5. Adjustment/Test Double-Wall Duct Connectors

A. Test Connectors for Leakage

(1) Pressurize pneumatic manifold through ground pneumatic connection with a pressure of 28 (±2) psi ambient temperature (see Chapter 36).

(2) Place airfoil deicing switch in either timer position.

(3) Check connectors for no leakage by feel and sound.

(4) Increase pressure to 38 (±2) psi and hold for minimum of 2 minutes.

(5) Relieve pressure in deicing duct by placing airfoil deicing switch in off position.

(6) Check fail-safe indicator band of all flexible double-wall duct connectors for general condition and tripped indication.

(7) Depressurize pneumatic manifold and disconnect ground pneumatic source (see Chapter 36).

AIR FOIL - ADJUSTMENT/TEST

1. General

   This test checks airflow from the deicing valves and compares the amount of airflow in pounds per minute with the established allowable amount.

2. Tools and Equipment Required

   NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Air pressure gage (with range of 0 to 60 psi and an accuracy within ±0.6 psi and suitable for connection to test boss on right rain removal duct, located in fuselage nose.)			Measure pressure in airplane pneumatic manifold
B	Pneumatic power ground source (capable of maintaining 38 (±1/2) psig at a flow rate of between 2 and 225 pounds per minute at ambient temperature)			Furnish pneumatic power for deicing valve airflow tests
C	28-volt test light			Voltage tests

3. Adjustment/Test Deicing System Functional

A. Test Deicing System

NOTE: The wing slot doors must be closed during the following test procedures and must be hydraulically loaded to avoid damage to the door seals. The position of the door is controlled by the wing flap control handle (see steps (2) through (5)).

(1) Make certain that following flight compartment controls and switches are in positions indicated:

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter ignition switches	Off

(2) Check that hydraulic system selector control lever is in general system (normal) position (see Chapter 29).

CAUTION: BEFORE PRESSURIZING HYDRAULIC POWER SYSTEM, MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(3) Connect a hydraulic test stand to ground pressure and supply connections (see Chapter 29).

(4) Pressurize hydraulic power system (see Chapter 20).

(5) Place wing flap control handle in up detent.

(6) Open access door 2 (see Chapter 20) and pressurize pneumatic manifold through fuselage nose ground pneumatic connector, and check valve.

NOTE: The pneumatic power required for the test is supplied from a ground source and is maintained at 38 (±2) psi at a temperature not to exceed 93.3°C (200°F). The air supplied to ground pneumatic connector must have a cleanness equivalent to that obtained by using a 10-micron filter and must have a minimum amount of entrained oil and water.

(7) Pull out and turn airfoil deicing timer cycle selector knobs for timer 1 and timer 2 to normal cycle position.

(8) Turn airfoil deicing timer cycle temperature knob for both timers to test position.

(9) Place airfoil deicing switch in timer 1 position. The timer operation should requre 23 to 31 seconds for a complete cycle.

(10) Make certain that tail duct valve and outer wing pneumatic duct shutoff valves are open, checking by sound or feel for airflow through left and right horizontal stabilizer tip bleeds. (On airplanes 801 - 811, also check outer wing vent scoops).

(11) Place airfoil deicing switch in timer 2 position. The results should be as outlined in steps (9 and 10).

(12) Place airfoil deicing switch in off position. Tail duct valve and outer wing pneumatic duct shutoff valves should close. Check by sound or feel that there is no airflow through areas listed in step (10).

(13) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of circuit breaker panel.

(14) Open landing gear warning and interlock circuit breaker, located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(15) Connect jumper wire between terminals C2 and C3 of left air conditioning system ground control relay.

(16) Disconnect and cap electrical connector from No. 1 (No. 7 on airplanes 801 - 811) right deicing valve to reduce required airflow.

(17) Close airfoil deicing valves circuit breaker.

(18) Pull out and turn airfoil deicing timer cycle selector knob for timer 1 to long cycle position.

(19) Turn airfoil deicing timer 1 temperature knob to -5 degrees ram air temperature position.

(20) Place airfoil deicing switch in timer 1 position. Timer required from 4 minutes 21 seconds to 5 minutes, 54 seconds (2 minutes 53 seconds to 3 minutes 54 seconds on airplanes 801 - 811) for complete cycle. Check by sound or feel that each deicing valve operates in proper sequence (see Figure 501 and 502), with exception of disconnected No. 1 or No. 7 right valve, as applicable.

NOTE: The wing slot door seals can be checked along wing span areas of seals when appropriate deicing valves are open. There should be no leakage in these areas, but leakage is acceptable at door ends. For closer monitoring of these conditions, timer cycle can be interrupted by opening airfoil deicing timer 1 circuit breaker. This action stops the timer without affecting airflow to selected deicing valves; all interruptions correspondingly lengthen total timer cycle period.

(21) Repeat procedures or steps (18) through (20) for timer 2, except door seal check. Results should be same as in step (20).

(22) Place airfoil deicing switch in off position.

(23) Open airfoil deicing valves circuit breaker.

(24) Place pneumatic crossfeed switch in closed position.

(25) Connect electrical connector to No. 1 or No. 7 right deicing valve, as applicable.

(26) Place airfoil deicing switch in either timer position and operate timer to position 12 (position 6 on airplanes 801 - 811).

(27) Close airfoil deicing valve circuit breaker. On airplanes 812 - 819, check that No. 1 right valve opens and then closes as timer operates through position 1. On airplanes 801 - 811, check that No. 7 valve opens and then closes as timer operates through position 7.

(28) Place airfoil deicing switch in off position.

(29) Place pneumatic crossfeed switch in down and guarded position.

(30) Shut off ground air supply, and relieve pneumatic manifold pressure.

NOTE: The procedure in steps (32) through (36) check increased deicing rate circuitry for wing slot areas. Deicing airflow is not used in test because fuselage nose ground pneumatic connector could not handle volume of air required.

(31) Depressurize hydraulic power system (see Chapter 29).

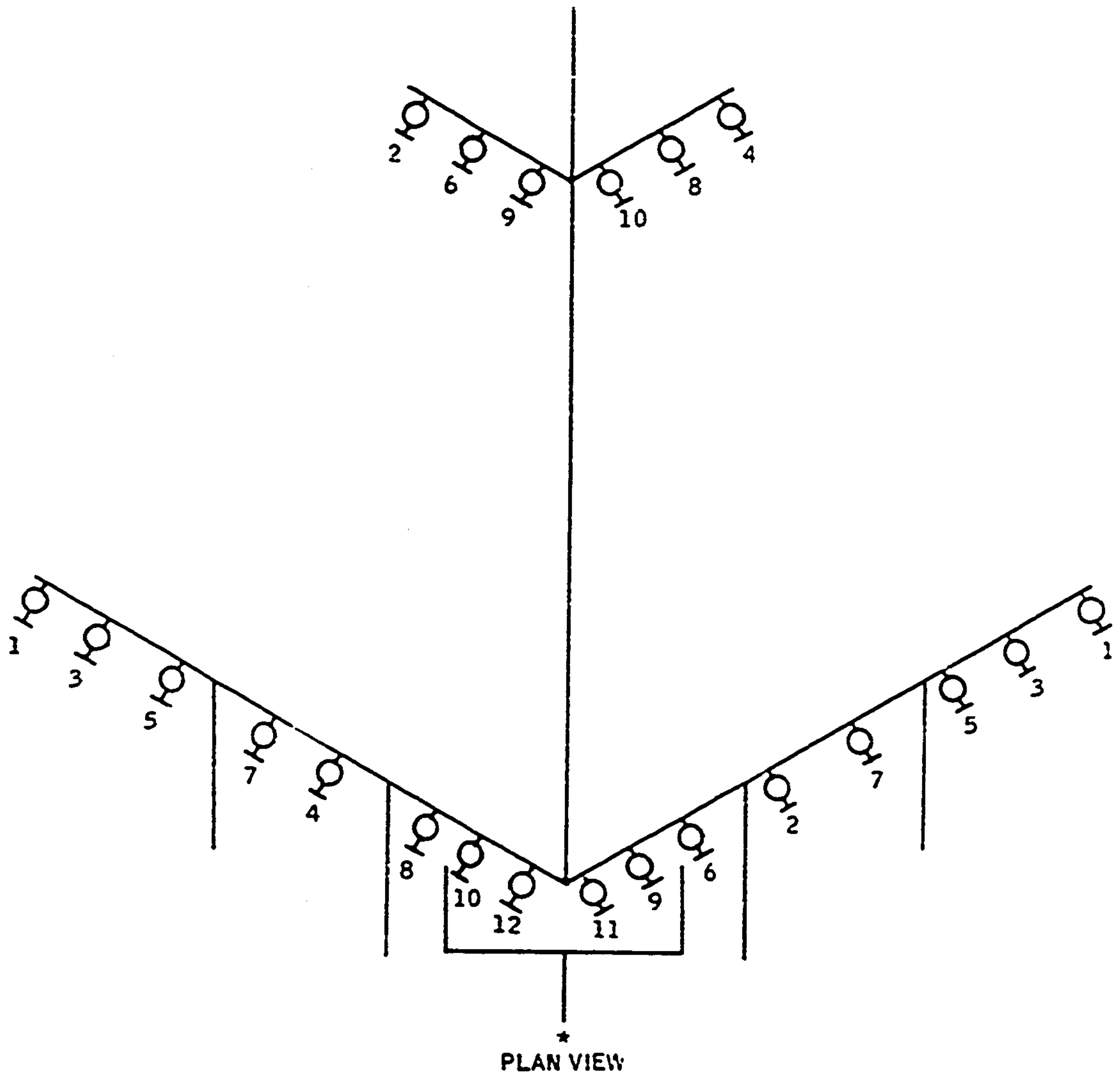
(32) Close landing gear warning and interlock circuit breaker.

(33) Adjust temperature and cycle selector knobs of either airfoil deicing timer to any convenient rate.

Valve Number	Valve Location	Access Door
1	Outer Wing Outer Wing	518A 518A
2	Center Horizontal Stabilizer	522B 64A
3	Outer Wing Outer Wing	519A 519A
4	Center Wing Horizontal Stabilizer	522B 64A
5	Outer Wing Outer Wing	519C 519C
6	Inner Wing Horizontal Stabilizer	520D 64D
7	Center Wing Center Wing	522A 522A
8	Inner Wing Horizontal Stabilizer	520D 64D
9	Horizontal Stabilizer * Inner Wing	64G 520E
10	Horizontal Stabilizer * Inner Wing	64G 520E
11	* Inner Wing	520G
12	* Inner Wing	520G

* Applicable to airplanes 801 - 804 only.

Airfoil Deicing System Valve Location
Figure 501



NOTE:
* THESE VALVES APPLICABLE TO AIRPLANES 801 THROUGH 804 ONLY

HA2-5285

Airfoil Deicing System Valve Operating
Sequence -- Schematic
Figure 502

(34) Locate electrical terminal strip on right side of forward bulkhead in accessory compartment.

(35) Place airfoil deicing switch in chosen timer position.

(36) Connect 28-volt test light between nearest convenient ground stud and terminal corresponding to timer position as follows:

CAUTION: TEST AREA MUST BE FREE OF COMBUSTIBLE VAPORS BECAUSE FOLLOWING CHECKS COULD PROVIDE AN ARC.

Timer Position	On terminal strip power should	
	Exist at terminal	Not exist at terminal
1	9	6
2	2	1, 10, 64
3	5	8, 29, 30
4	5	7
5	9	4
6	-	-
7	-	-
8	-	-
9	2	3
10	2	-
11	5	-
12	5	-

NOTE: The chosen timer motor can be stopped at any desired position by opening the applicable deicing timer circuit breaker. The timer resumes the cycle when the circuit breaker is again closed.

(37) Place airfoil deicing switch in off position.

(38) Open airfoil deicing valves circuit breaker.

(39) Remove jumper installed on ground control relay between terminals C2 and C3.

(40) Close airfoil deicing valves circuit breaker.

(41) Test tail duct valve and tail deicing system indicating light using procedures outlined in 30-10-2.

4. Adjustment/Test Airfoil Deicing System

A. Test Airfoil Deicing System Airflow

(1) Place following controls in the positions indicated:

Control	Position
Starter/ignition switches	Off
Pneumatic shutoff switches	Off
Fire control handles	Normal
Windshield rain removal levers	Off
Engine anti-icing switch	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Cabin compressor switches	Off
Freon compressor switches	Off
Tail duct valve switch	Normal
Pneumatic manifold crossfeed shutoff switch	Down and guarded

NOTE: The wing slot doors may be either open or closed during the following test procedures, but if they are closed they should be hydraulically loaded to avoid damage to the door seals. The position of the doors is controlled by the wing flap control lever (see steps 2 through 5).

(2) Check that hydraulic system selector control lever is in general system (normal) position.

(3) Connect hydraulic test stand to ground pressure and supply connections (see Chapter 29).

(4) Pressurize hydraulic power system (see Chapter 29).

CAUTION: BEFORE PRESSURIZING HYDRAULIC POWER SYSTEM, MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(5) Place wing flap handle in up detent.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT AREAS AROUND LEFT AND RIGHT FLAPS AND WING SLOTS ARE CLEAR OF PERSONNEL AND EQUIPMENT.

(6) Connect air pressure gage to test boss located on bottom of right rain removal duct next to low-pressure pneumatic manifold crossfeed shutoff valve.

(7) Connect pneumatic power ground source and pressurize airplane pneumatic manifold to 38 (±1/2) psig at ambient temperature (see Chapter 36).

NOTE: Manifold pressure should be maintained at 38 (±1/2) psig at ambient temperature under all conditions of airflow. It is more convenient to monitor manifold pressure by this gage than by manifold pressure in flight compartment.

(8) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of EPC circuit breaker panel.

(9) Disconnect and [illegible] electrical connector from No. 1 right deicing valve (No. 7 [illegible] valve on airplanes 801 - 8[illegible]1) to reduce volume of air req[illegible].

(10) Close al[illegible] valves circuit breaker.

(11) Place airfoil deicing switch in timer 1 position. Check by sound or feel for airflow at left and right horizontal stabilizer tip bleeds. On airplanes 801 - 811, also check outer wing vent scoops.

(12) When airflow stabilizes, measure and record flow in column 1 on applicable flow chart.

(13) Open airfoil deicing timer 1 circuit breaker, located on heat, vent and ice protection (ac bus) section of EPC circuit breaker panel. Timer 1 should stop.

(14) Open landing gear warning and interlock circuit breaker, located on miscellaneous (dc bus) section of the circuit breaker panel.

(15) Open the airfoil deicing valves circuit breaker, located on the heat, vent and ice protection (dc bus) section of circuit breaker panel.

(16) Locate left air conditioning system ground control relay. Connect a jumper wire between terminals C2 and C3.

(17) Close airfoil deicing valves circuit breaker.

(18) Check timer window to determine which two deicing valves are selected.

(19) Check that two indicated deicing valves are open (except No. 1R or No. 7R as applicable in right wing). Check by sound or feel for airflow in areas listed on deicing sequence chart (see Figure 501) and in Figure 502.

(20) Measure and record airflow in column 2 on applicable flow chart (see Figure 503).

(21) Compute measurement for column 3 and compare with allowable range listed in column 4 of flow chart.

(22) Close airfoil deicing timer 1 circuit breaker. When timer window indicates that deicing system is in next sequence, open circuit breaker.

(23) Check that two deicing valves that were open in step (19) are now closed, and that two deicing valves now indicated by timer w[illegible] are open (with exception of No. 1R or No. 7R as applicable). Ch[illegible] by sound or feel for airflow in areas listed on deicing sequence chart and in Figure 502.

(24) Measure and record airflow in column 2 on flow chart.

(25) Compute measurement for column 3 and compare with allowable range listed in column 4 of flow chart.

(26) Repeat steps (20) through (25) until flow has been measured and recorded for all timer positions.

(27) Check valves and connections corresponding to timer positions 6, 7L and 8 by sound or feel for leakage at duct connections to wing leading edge slot lower doors.

(28) Check for leakage at seals between slot vanes and lower doors.

NOTE: No leakage is permissible in the spanwise areas of seals. Mode[illegible] leakage is permissible at door ends.

(29) Check duct connections which correspond to timer positions 6, 7 and 8 by listening or feeling for leakage at inner and center wing duct connectors (on airplanes 801 - 811, omit check on timer position 7).

(30) Open airfoil deicing valves circuit breaker.

Deicing Valves	1	2	3	4	
	Measured Flow (lb/min)	Measured Flow (lb/min)	Deicing Valve Flow -- column 2 less column 1 (lb/min)	Allowable Flow (lb/min) Min.	Max.
1				126.0	144.0
2				115.0	132.0
3				118.0	136.0
4				115.0	132.0
5				118.0	136.0
6				89.0** (121.0)***	100.0** (140.0)***
7L				93.0	109.0
8*				89.0** (124.0)***	104.0** (143.0)***
9*				33.0 114.0†	39.0 131.0†
10				35.0 116.0†	41.0 134.0†
11				54.0†	61.0†
12				79.0†	89†
7R				93.0	109.0

Test air: Temp. ________ °F

O.A.T. = ________ °F

Press. ________ psi

* Tail valves only.
** Flow limits applicable to airplanes equipped with wing leading edge fuel tanks.
*** Flow limits applicable to airplanes not equipped with wing leading edge fuel tanks.
† Flow limits applicable to airplanes 801 through 804.

Flow Chart (Airplanes 801 - 811)
Figure 503 (Sheet 1)

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	1	2	3	4	
Deicing Valves	Measured Flow (lb/min)	Measured Flow (lb/min)	Deicing Valve Flow -- column 2 less column 1 (lb/min)	Allowable Flow (lb/min) Min.	Max.
1L				83	96
2				140	161
3				146	167
4				140	161
5				140	162
6				60	69
7				133	153
8				60	70
9				33	39
10				35	41
1R				83	96

Test air: Temp. _________ °F

O.A.T. = _______ °F

Press. _________ psi

Flow Chart (Airplanes 812 - 822)
Figure 503 (Sheet 2)

(31) Place the pneumatic crossfeed switch in closed position.

(32) Check that no airflow exists at left and right horizontal stabilizer tip bleeds. On airplanes 801 - 811, also check outer wing vent scoops.

(33) Remove caps and connect electrical connector to No. 1R or No. 7R deicing valve as applicable.

(34) Close airfoil deicing valves circuit breaker.

(35) Close airflow deicing timer 1 circuit breaker and reopen when 1R or 7R, as applicable, appears in timer window.

(36) Check by sound or feel that No. 1R or 7R deicing valve, as applicable, is open.

(37) Check for leakage for 7R at seal between slot vane and lower door as applicable.

(38) Measure and record airflow in column 2 on flow chart.

(39) Open airfoil deicing valves circuit breaker.

(40) Check by sound or feel that No. 1R or 7R deicing valve, as applicable, is closed.

(41) Record remaining airflow.

(42) Compute measurement for column 3 by subtracting value in step (41) from step (38) and compare difference with allowable range listed in column 4 of flow chart.

(43) Place airfoil deicing switch in off position

(44) Close airfoil deicing timer 1 circuit breaker.

(45) Remove jumper wire connected between terminals C2 and C3 of air-conditioning ground control relay.

(46) Close airfoil deicing valves circuit breaker.

(47) Close landing gear warning and interlock circuit breakers.

(48) Depressurize pneumatic manifold and disconnect ground pneumatic source from fuselage nose ground pneumatic connector.

(49) Place pneumatic crossfeed switch in down and guarded position.

(50) Check fail-safe indicator band of all flexible, double-wall duct connectors in tail deicing supply duct in pressurized area of fuselage.

(51) Check all deicing valve hose connections for general condition.

(52) Depressurize hydraulic power system (see Chapter 29).

(53) Disconnect hydraulic test stand from ground pressure and supply connections (see Chapter 29).

5. Adjustment/Test Double-Wall Duct Connectors

A. Test Connectors For Leakage

(1) Pressurize pneumatic manifold through ground pneumatic connection with a pressure of 28 (±0.5) psi ambient temperature (see Chapter 36).

(2) Place airfoil deicing switch in either timer position.

(3) Check connector for no leakage by feel and sound.

(4) Increase pressure to 38 (±0.5) psi and hold for minimum of 2 minutes.

(5) Relieve pressure in duct by placing airfoil deicing switch in off position.

(6) Check connector fail-safe indicator band for general condition and tripped indication.

(7) Depressurize pneumatic manifold and disconnect ground pneumatic source (see Chapter 36).

AIRFOIL - ADJUSTMENT/TEST

1. General

   A. This test checks airflow from the deicing valves and compares the amount of airflow in pounds per minute with the established allowable amount.

2. Tools and Equipment Required

   NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Air pressure gage (with range of 0 to 60 psi and an accuracy within ±0.6 psi and suitable for connection to test boss on right rain removal duct, located in fuselage nose)			Measure pressure in airplane pneumatic manifold
B	Pneumatic power ground source (capable of maintaining 38 (±2) psig at a flow rate of between 2 and 225 pounds per minute at ambient temperature)			Furnish pneumatic power for deicing valve airflow tests
C	28-volt test light			Voltage tests

3. Adjustment/Test Deicing System Functional

A. Test Deicing System

NOTE: The wing slot doors must be closed during the following test procedures and must be hydraulically loaded to avoid damage to the door seals. The position of the door is controlled by the wing flap control handle (see steps 2 through 5).

(1) Make certain that following flight compartment controls and switches are in positions indicated:

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Check that hydraulic system selector control lever is in general system (normal) position (see Chapter 29).

CAUTION: BEFORE PRESSURIZING HYDRAULIC POWER SYSTEM, MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(3) Connect a hydraulic test stand to ground pressure and supply connections (see Chapter 29).

(4) Pressurize hydraulic power system (see Chapter 29).

(5) Place wing flap control handle in up detent.

(6) Pressurize pneumatic manifold through pneumatic ground connector.

NOTE: The pneumatic power required for the test is supplied from a ground source and is maintained at 38 (±2) psi at a temperature not to exceed 93.3°C (200°F). The air supplied to ground pneumatic connector must have a cleanness equivalent to that obtained by using a 10-micron filter and must have a minimum amount of entrained oil and water.

(7) Pull out and turn airfoil deicing timer cycle selector knobs for timer 1 and timer 2 to normal cycle position.

(8) Turn airfoil deicing timer cycle temperature knob for both timers to test position.

(9) Place airfoil deicing switch in timer 1 position. Timer operation should require 23 to 31 seconds for complete cycle.

(10) Make certain that tail duct valve is closed and outer wing pneumatic duct shutoff valves are open.

(11) Place airfoil deicing switch in timer 2 position. Results should be as outlined in steps (9 and 10).

(12) Place airfoil deicing switch in off position. Outer wing pneumatic duct shutoff valves should close. Check by sound or feel that there is no airflow.

(13) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of circuit breaker panel.

(14) Open left and right ground control relay circuit breakers located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(15) Disconnect and cap electrical connector from No. 6 right deicing valve (to reduce required airflow).

(16) Close airfoil deicing valves circuit breaker.

(17) Pull out and turn airfoil deicing timer cycle selector knob for timer 1 to long cycle position.

(18) Turn airfoil deicing timer 1 temperature knob to -5° ram air temperature position.

(19) Place airfoil deicing switch in timer 1 position. Timer requires from 4 minutes 21 seconds to 5 minutes 54 seconds for complete cycle. Check by sound or feel that each deicing valve operates in proper sequence (see Figures 501 and 502), with exception of disconnected No. 6 right valve.

NOTE: The wing slot door seals can be checked along wing span areas of seals when appropriate deicing valves are open. There should be no leakage in these areas, but leakage is acceptable at door ends. For closer monitoring of these conditions, timer cycle can be interrupted by opening airfoil deicing timer 1 circuit breaker. This action stops the timer without affecting airflow to selected deicing valves; all interruptions correspondingly lengthen total timer cycle period.

(20) Repeat procedures or steps (17 through 19) for timer 2 except door seal check. Results should be same as in step (19).

(21) Place airfoil deicing switch in timer 1 position.

(22) Make certain tail duct valve switch is in normal position.

(23) Press tail deice pushbutton switch. Check following:

(a) Tail duct valve should open and air should flow to horizontal stabilizer for 150 (±15) seconds.

(b) Time will stop and there should be no air flow to wing leading edge during cycle period.

NOTE: If pushbutton is reactuated during any part of a preceding cycle, a new cycle will begin. The tail deice system warning light will come on momentarily during initial opening of tail duct valve.

(24) Place airfoil deice switch in timer 2 position.

(25) Repeat steps (22 and 23).

(26) Place and hold timer override switch in timer override position.

(27) Tail duct valve should open and air should flow to horizontal stabilizer until switch is released.

(28) Return timer override switch to normal position.

(29) Place airfoil deicing switch in off position.

Valve Number	Valve Location	Access Door
2	Center	522B
3	Outer Wing Outer Wing	519A 519A
4	Center Wing	522B
5	Outer Wing Outer Wing	519C 519C
6	Outer Wing Outer Wing	518A 518A
7	Center Wing Center Wing	522A 522A
8	Inner Wing Inner Wing	520D 520D

Airfoil Deicing System Valve Location
Figure 501

(30) Open airfoil deicing valves circuit breaker.

(31) Place pneumatic crossfeed switch in closed position.

(32) Connect electrical connector to No. 6 right deicing valve.

(33) Place airfoil deicing switch in either timer position and operate timer to position 5.

(34) Close airfoil deicing valve circuit breaker. Check that No. 6 right valve opens and then closes as timer operates through position 6.

(35) Place airfoil deicing switch in off position.

(36) Place pneumatic crossfeed switch in down and guarded position.

(37) Shut off ground air supply, and relieve pneumatic manifold pressure.

(38) Depressurize hydraulic power system (see Chapter 29).

NOTE: The procedure in steps (39 and 40) check increased deicing rate circuitry for wing slot areas. Deicing airflow is not used in test because fuselage nose ground pneumatic connector could not handle volume of air required.

(39) Adjust temperature and cycle selector knobs of either airfoil deicing timer to any convenient rate.

(40) Locate burndy block on right side of forward bulkhead in accessory compartment.

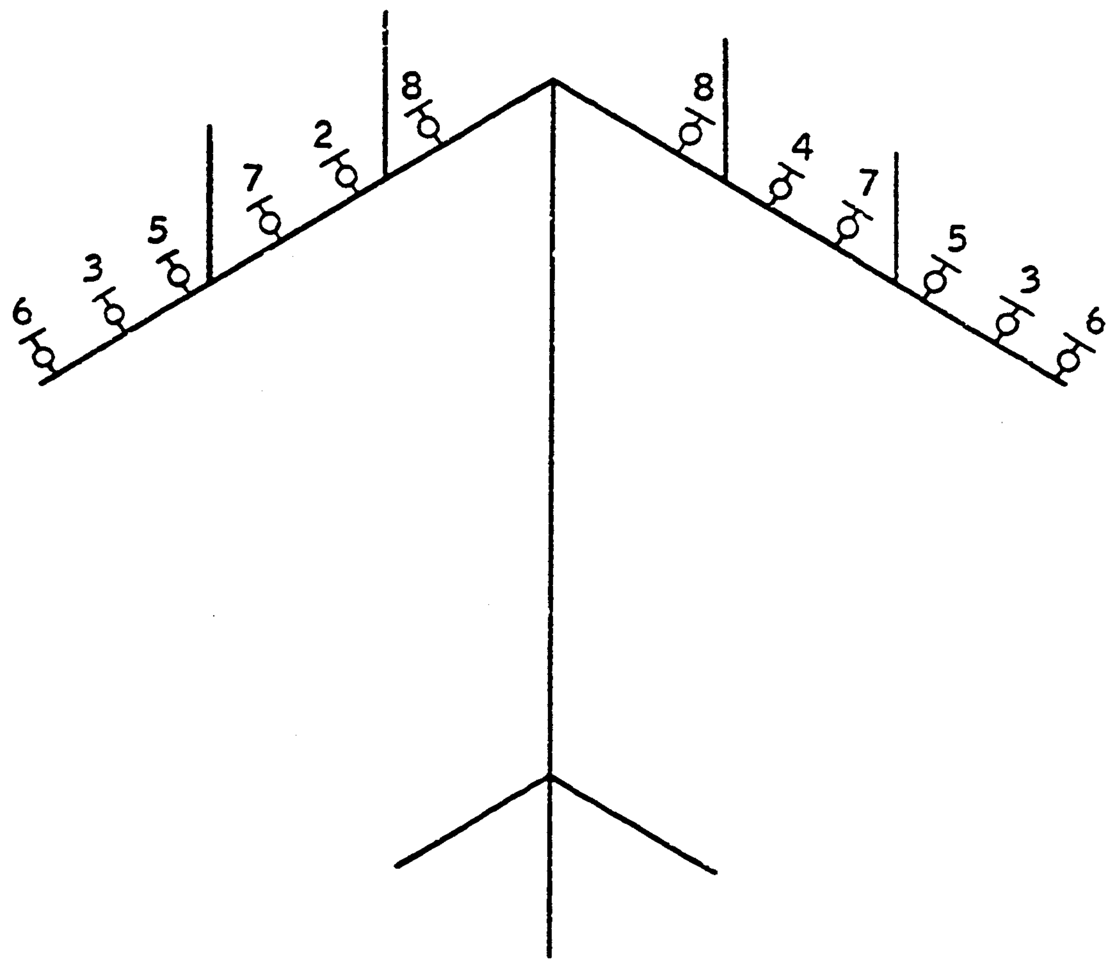
(41) Place airfoil deicing switch in chosen timer position.

(42) Connect 28-volt test light between nearest convenient ground stud and terminal corresponding to timer position as follows:

CAUTION: TEST AREA MUST BE FREE OF COMBUSTIBLE VAPORS BECAUSE FOLLOWING CHECKS COULD PROVIDE AN ARC.

Timer Position	On burndy block power should	
	Exist at terminal	Not exist at terminal
6	-	-
2	50	49
3	50	58X
4	51	-
5	-	-
8	-	-
7	-	-
8	-	-
9	-	-
10	50	49, 58X
11	50	49, 58X
12	51	58A

NOTE: The chosen timer motor can be stopped at any desired position by opening the applicable deicing timer circuit breaker. The timer resumes the cycle when the circuit breaker is again closed.



HA2-2721

Airfoil Deicing System Valve Operating
Sequence -- Schematic
Figure 502

4. Adjustment/Test Airfoil Deicing System Airflow

A. Test Airfoil Deicing System Airflow

(1) Place following controls in the positions indicated:

Control	Position
Starter/ignition switches	Off
Pneumatic shutoff switches	Off
Fire control handles	Normal
Windshield rain removal levers	Off
Engine anti-icing switch	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Cabin compressor switches	Off
Freon compressor switches	Off
Tail duct valve switch	Normal
Pneumatic manifold crossfeed shutoff switch	Down and guarded

NOTE: The wing slot doors may be either open or closed during the following test procedures, but if they are closed they should be hydraulically loaded to avoid damage to the door seals. The position of the doors is controlled by the wing flap control lever (see steps 2 through 5).

(2) Check that hydraulic system selector control lever is in general system (normal) position.

(3) Connect hydraulic test stand to ground pressure and supply connections (see Chapter 29).

(4) Pressurize hydraulic power system (see Chapter 29).

CAUTION: BEFORE PRESSURIZING HYDRAULIC POWER SYSTEM, MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(5) Place wing flap handle in up detent.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT AREAS AROUND LEFT AND RIGHT FLAPS AND WING SLOTS ARE CLEAR OF PERSONNEL AND EQUIPMENT.

(6) Connect air pressure gage to test boss located on bottom of right rain removal duct next to low-pressure pneumatic manifold crossfeed shutoff valve.

(7) Connect pneumatic power ground source and pressurize airplane pneumatic manifold to 38 (±2) psig at ambient temperature (see Chapter 36).

NOTE: Manifold pressure should be maintained at 38 (±2) psig at ambient temperature under all conditions of airflow. It is more convenient to monitor manifold pressure by this gage than by manifold pressure in flight compartment.

(8) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of EPC circuit breaker panel.

(9) Disconnect and cap electrical connector from No. 6 right deicing valve to reduce volume of air required for test.

(10) Close airfoil deicing valves circuit breaker.

(11) Place airfoil deicing switch in timer 1 position. Check by sound or feel for airflow at left and right wing tip bleeds.

(12) When airflow stabilizes, measure and record flow in column 1 on flow chart (see Figure 503).

(13) Open airfoil deicing timer 1 circuit breaker, located on heat, vent and ice protection (ac bus) section of EPC circuit breaker panel. Timer 1 should stop.

(14) Open landing gear warning and interlock circuit breaker, located on miscellaneous (dc bus) section of circuit breaker panel.

(15) Open left and right ground control relay circuit breakers located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(16) Check timer window to determine which two deicing valves are selected.

(17) Check that two indicated deicing valves are open (except No. 6R in right wing). Check by sound or feel for airflow in area of corresponding deicing valve (see Figures 501 and 502).

(18) Measure and record airflow in column 2 on flow chart (see Figure 503).

(19) Compute measurement for column 3 and compare with allowable range listed in column 4 of flow chart.

(20) Close airfoil deicing timer 1 circuit breaker. When timer window indicates that deicing system is in next sequence, open circuit breaker.

(21) Check that two deicing valves that were open in step (17) are now closed, and that two deicing valves now indicated by timer window are open (with exception of No. 6). Check by sound or feel for airflow in areas listed on deicing sequence chart and in Figure 502.

(22) Measure and record airflow in column 2 on flow chart.

(23) Compute measurement for column 3 and compare with allowable range listed in column 4 of flow chart.

(24) Repeat steps (18 through 23) until flow has been measured and recorded for all timer positions.

(25) Check valves and connections corresponding to timer positions 7 and 8 by sound or feel for leakage at duct connections to wing leading edge slot lower doors.

(26) Check for leakage at seals between slot vanes and lower doors.

NOTE: No leakage is permissible in the spanwise areas of seals. Moderate leakage is permissible at door ends.

(27) Check duct connections which correspond to timer positions 7 and 8 by listening or feeling for leakage at inner and center wind duct connectors.

(28) Open airfoil deicing valves circuit breaker.

(29) Connect electrical connector to No. 6 deicing valve.

(30) Close airfoil deicing valves circuit breaker.

(31) Close airflow deicing timer 1 circuit breaker and reopen when 6 appears in timer window.

(32) Check by sound or feel that No. 6 deicing valve is open.

(33) Check for leakage for 7 at seal between slot vane and lower door as applicable.

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(34) Measure and record airflow in column 2 on flow chart.

(35) Open airfoil deicing valves circuit breaker.

	1	2	3	4	
Deicing Valves	Measured Flow (lb/min)	Measured Flow (lb/min)	Deicing Valve Flow -- Column 2 less Column 1 (lb/min)	Allowable Flow (lb/min) Min.	Max.
2				140	161
3				146	167
4				140	161
5				140	162
6				83	96
6				83	96
7				133	153
8				60	69
8				60	70
O.A.T. = __________ °F			Test air: Temp.__________ °F Press.__________ psi		

Flow Chart
Figure 503

(36) Check by sound or feel that No. 6 deicing valve is closed.

(37) Record remaining airflow.

(38) Compute measurement for column 3 by subtracting value in step (37) from step (34) and compare difference with allowable range listed in column 4 of flow chart.

(39) Close airfoil deicing timer 1 circuit breaker.

(40) Push tail deice pushbutton. Record airflow. Airflow should be 137 to 152 pounds per minute.

(41) Close left and right ground control relay circuit breakers located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(42) Close airfoil deicing valves circuit breaker.

(43) Close landing gear warning and interlock circuit breakers.

(44) Place pneumatic crossfeed switch in down and guarded position.

(45) Depressurize pneumatic manifold and disconnect ground pneumatic source from fuselage nose ground pneumatic connector (see Chapter 36).

(46) Depressurize hydraulic power system (see Chapter 29).

(47) Disconnect hydraulic test stand from ground pressure and supply connections (see Chapter 29).

5. Adjustment/Test Double-Wall Duct Connectors

A. Test Connectors for Leakage

(1) Pressurize pneumatic manifold through ground pneumatic connection with a pressure of 28 (±2) psi ambient temperature (see Chapter 36).

(2) Place airfoil deicing switch in either timer position.

(3) Check connectors for no leakage by feel and sound.

(4) Increase pressure to 38 (±2) psi and hold for minimum of 2 minutes.

(5) Relieve pressure in deicing duct by placing airfoil deicing switch in off position.

(6) Check fail-safe indicator band of all flexible double-wall duct connectors for general condition and tripped indication.

(7) Depressurize pneumatic manifold and disconnect ground pneumatic source (see Chapter 36).

OUTER WING PNEUMATIC DUCT SHUTOFF VALVES - MAINTENANCE PRACTICES

1. General

   A. The outer wing pneumatic duct shutoff valves are located at the junction of the low-pressure pneumatic manifold and the outer wing pneumatic duct. Access to the shutoff valves is through wing access door 512A.

   B. The removal and installation procedures for both pneumatic duct shutoff valves are identical.

2. Tools and Equipment Required

   A. DC-200 Dow Corning silicone lubricant (100,000 centistokes viscosity) or equivalent is used to lubricate rubber seal.

3. Removal/Installation Outer Wing Pneumatic Duct Shutoff Valve

   A. Remove Shutoff Valve

      (1) Open outer wing pneumatic duct valves circuit breaker, located on heat, vent, and ice protection dc bus section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Disconnect and cap electrical connector from outer wing pneumatic duct shutoff valve.

      (3) Loosen clamp connecting shutoff valve to pneumatic manifold.

      (4) Remove split clamp connecting shutoff valve to outer wing pneumatic duct.

      (5) Remove and discard old seal.

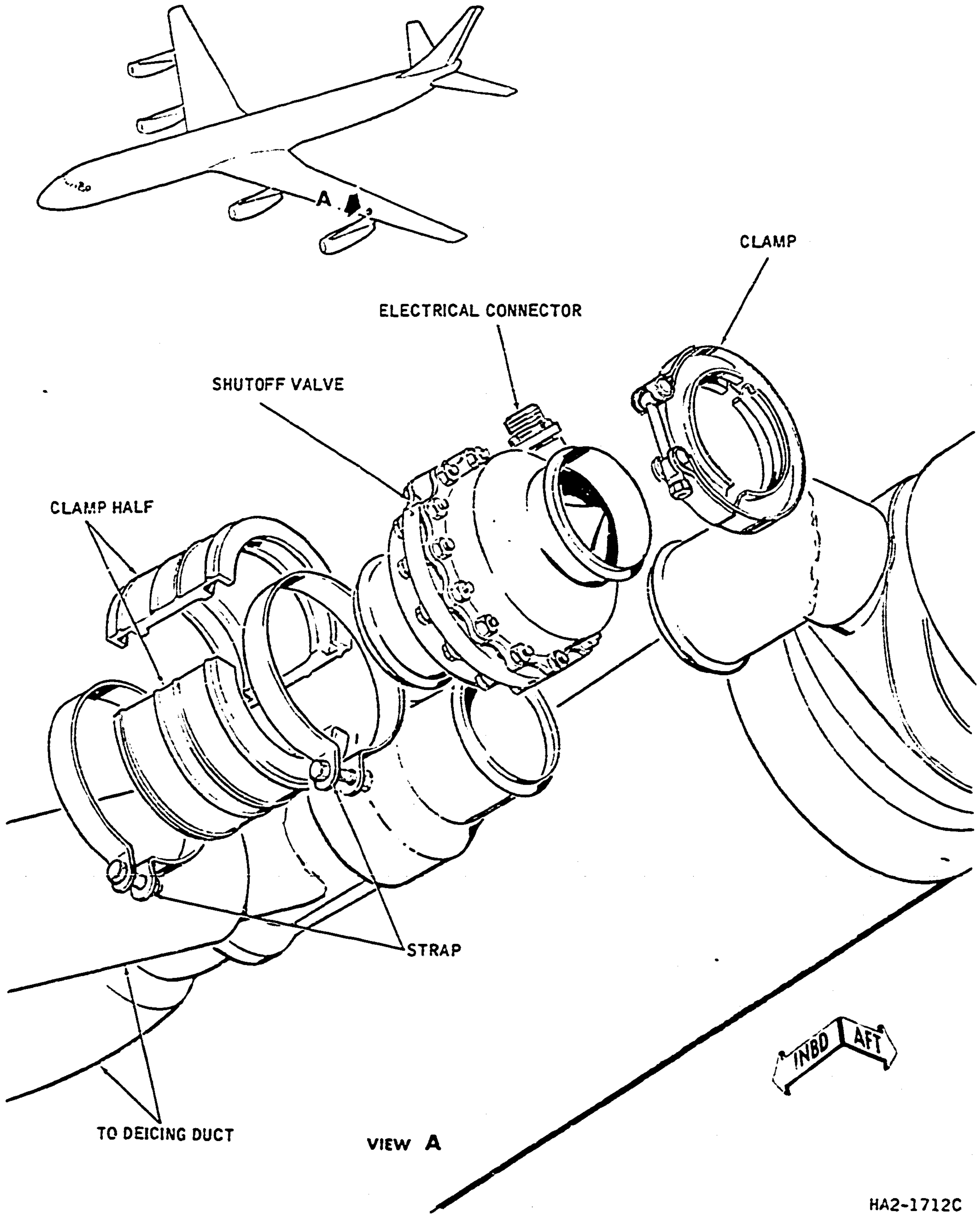
      (6) Remove valve.

      CAUTION: PROTECT OPEN PORTS AND LINES WITH PLASTIC CAPS. KEEP CAPS IN CLEAN CONTAINER WHEN NOT IN USE

   B. Install Shutoff Valve

      (1) Make certain that outer wing pneumatic duct valves circuit breaker, located on heat, vent, and ice protection section of EPC circuit breaker panel, is open.

      (2) Position pneumatic duct shutoff valve between pneumatic manifold and outer wing pneumatic duct.



Outer Wing Pneumatic Duct Shutoff Valve --
Removal/Installation
Figure 201

(3) Tighten clamp at pneumatic manifold to torque of 45 (±5) inch-pounds.

(4) Lubricate new seal with silicone lubricant, DC-200 or equivalent, and install on outlet side of duct.

(5) Install split clamp. Tighten clamp nut to torque of 50 to 70 inch-pounds.

NOTE: Total gap between both coupling halves must not exceed 1/32 inch after tightening.

(6) Connect electrical connector to shutoff valve.

(7) Close outer wing pneumatic duct valves circuit breaker.

4. Adjustment/Test Outer Wing Pneumatic Duct Shutoff Valve

A. Test Shutoff Valve

(1) Place following flight compartment controls and switches in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect pneumatic ground source and pressurize pneumatic manifold (see Chapter 36).

(3) Place scoops anti-icing switch in anti-ice position.

(4) Check for an audible airflow at applicable outer wing ventilation inlet scoop.

NOTE: Anti-icing airflow through the double-wall structure of the outer wing ventilation inlet scoop indicates that the outer wing pneumatic duct shutoff valve is open.

(5) Test latching feature of valve by opening outer wing pneumatic duct valves circuit breaker. Airflow should continue, indicating that valve is still open.

(6) Close outer wing pneumatic duct valves circuit breaker. Airflow should continue.

(7) Place scoops anti-icing switch in off position. Airflow should stop.

(8) Depressurize pneumatic manifold and disconnect ground pneumatic source. (See Chapter 36.)

OUTER WING PNEUMATIC DUCT SHUTOFF VALVES - MAINTENANCE PRACTICES

1. General

A. The outer wing pneumatic duct shutoff valves are located at the junction of the low-pressure pneumatic manifold and the outer wing pneumatic duct. Access to the shutoff valves is through wing access door 520A.

B. The removal and installation procedures for both pneumatic duct shutoff valves are identical.

2. Tools and Equipment Required

A. DC-200 Dow Corning silicone lubricant (100,000 centistokes viscosity) or equivalent is used to lubricate rubber seal.

3. Removal/Installation Outer Wing Pneumatic Duct Shutoff Valve

A. Remove Shutoff Valve

(1) Open outer wing pneumatic duct valves circuit breaker, located on heat, vent, and ice protection dc bus section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Disconnect and cap electrical connector from outer wing pneumatic duct shutoff valve.

(3) Loosen clamp connecting shutoff valve to pneumatic manifold.

(4) Remove split clamp connecting shutoff valve to outer wing pneumatic duct.

(5) Remove and discard old seal.

(6) Remove valve.

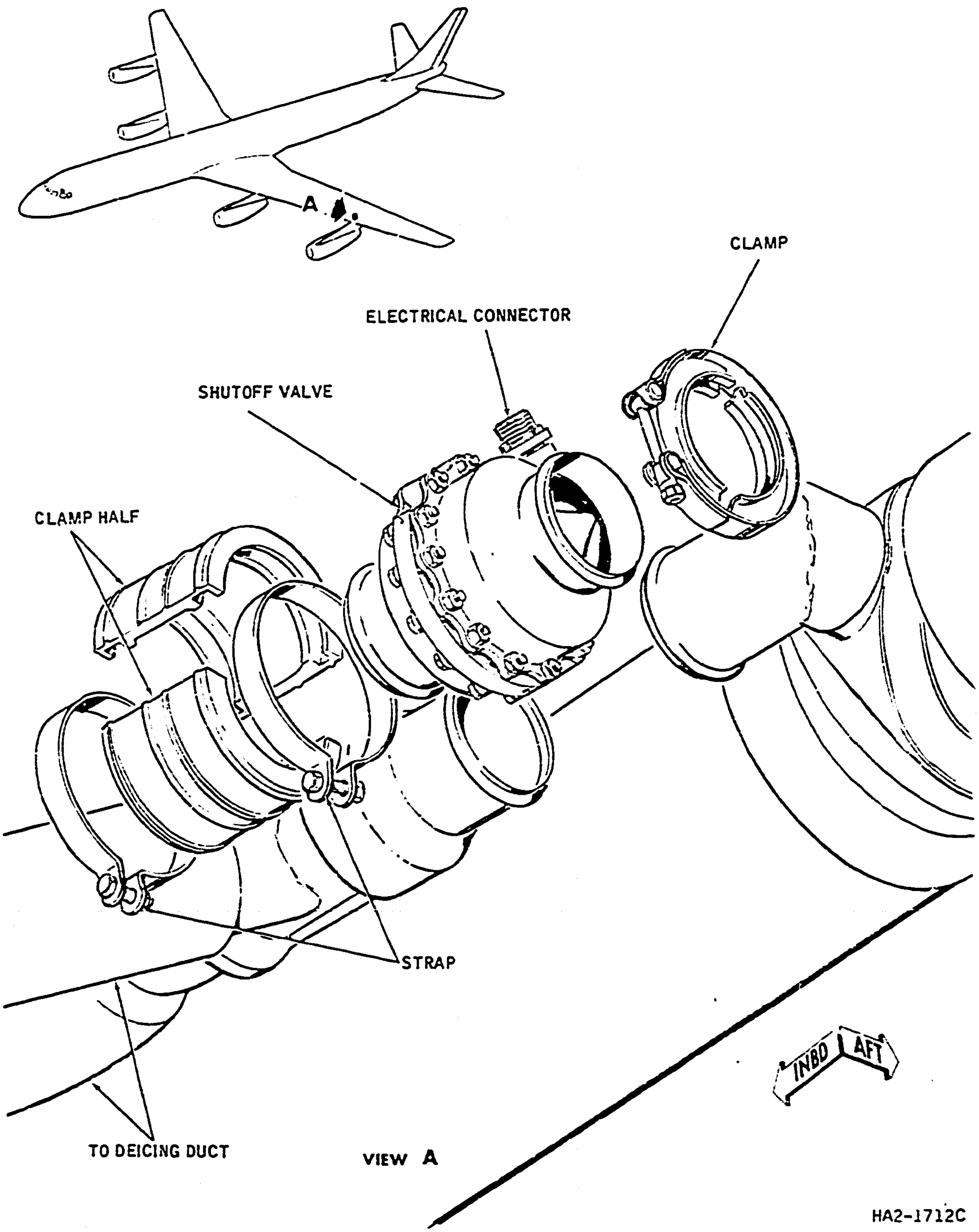
CAUTION: PROTECT OPEN PORTS AND LINES WITH PLASTIC CAPS. KEEP CAPS IN CLEAN CONTAINER WHEN NOT IN USE.

B. Install Shutoff Valve

(1) Make certain that outer wing pneumatic duct valves circuit breaker, located on heat, vent, and ice protection section of EPC circuit breaker panel, is open.

(2) Position pneumatic duct shutoff valve between pneumatic manifold and outer wing pneumatic duct.

(3) Tighten clamp at pneumatic manifold to torque of 45 (±5) inch-pounds.



Outer Wing Pneumatic Duct Shutoff Valve --
Removal/Installation
Figure 201

(4) Lubricate new seal with silicone lubricant, DC-200 or equivalent, and install on outlet side of duct.

(5) Install split clamp. Tighten clamp nut to torque of 50 to 70 inch-pounds.

NOTE: Total gap between both coupling halves must not exceed 1/32 inch after tightening.

(6) Connect electrical connector to shutoff valve.

(7) Close outer wing pneumatic duct valves circuit breaker.

4. Adjustment/Test Outer Wing Pneumatic Duct Shutoff Valve

A. Test Shutoff Valve

(1) Place following flight compartment controls and switches in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect pneumatic ground source and pressurize pneumatic manifold (see Chapter 36).

(3) Place scoops anti-icing switch in anti-ice position.

(4) Check for an audible airflow at applicable outer wing ventilation inlet scoop.

NOTE: Anti-icing airflow through the double-wall structure of the outer wing ventilation inlet scoop indicates that the outer wing pneumatic duct shutoff valve is open.

(5) Test latching feature of valve by opening outer wing pneumatic duct valves circuit breaker. Airflow should continue, indicating that valve is still open.

(6) Close outer wing pneumatic duct valves circuit breaker. Airflow should continue.

(7) Place scoops anti-icing switch in off position. Airflow should stop.

(8) Depressurize pneumatic manifold and disconnect ground pneumatic source (See Chapter 36.)

TAIL DUCT VALVE - MAINTENANCE PRACTICES

1. General

A. The tail duct valve is installed in the forward end of the tail duct at the junction of the wing and fuselage sections of the pneumatic manifold. The valve, located at the aft end of the left tunnel area, is accessible through access door No. 13.

2. Removal/Installation Tail Duct Valves

A. Remove Tail Duct Valve

(1) Open empennage deicing and warning circuit breaker, located on heat, vent and ice protection section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Disconnect and cap electrical connector from tail duct valve.

(3) Disconnect support rod attached to valve.

(4) Disconnect and cap sense line from valve.

(5) Disconnect and cap actuating air overboard vent line from valve.

(6) Loosen flexible duct connector that attaches outlet end of valve to tail duct.

(7) Remove attaching bolts that connect inlet end of valve to tail duct and remove valve. Discard gasket.

CAUTION: COVER ALL OPEN PORTS AND LINES TO PREVENT ENTRANCE OF FOREIGN MATERIAL.

B. Install Tail Duct Valve

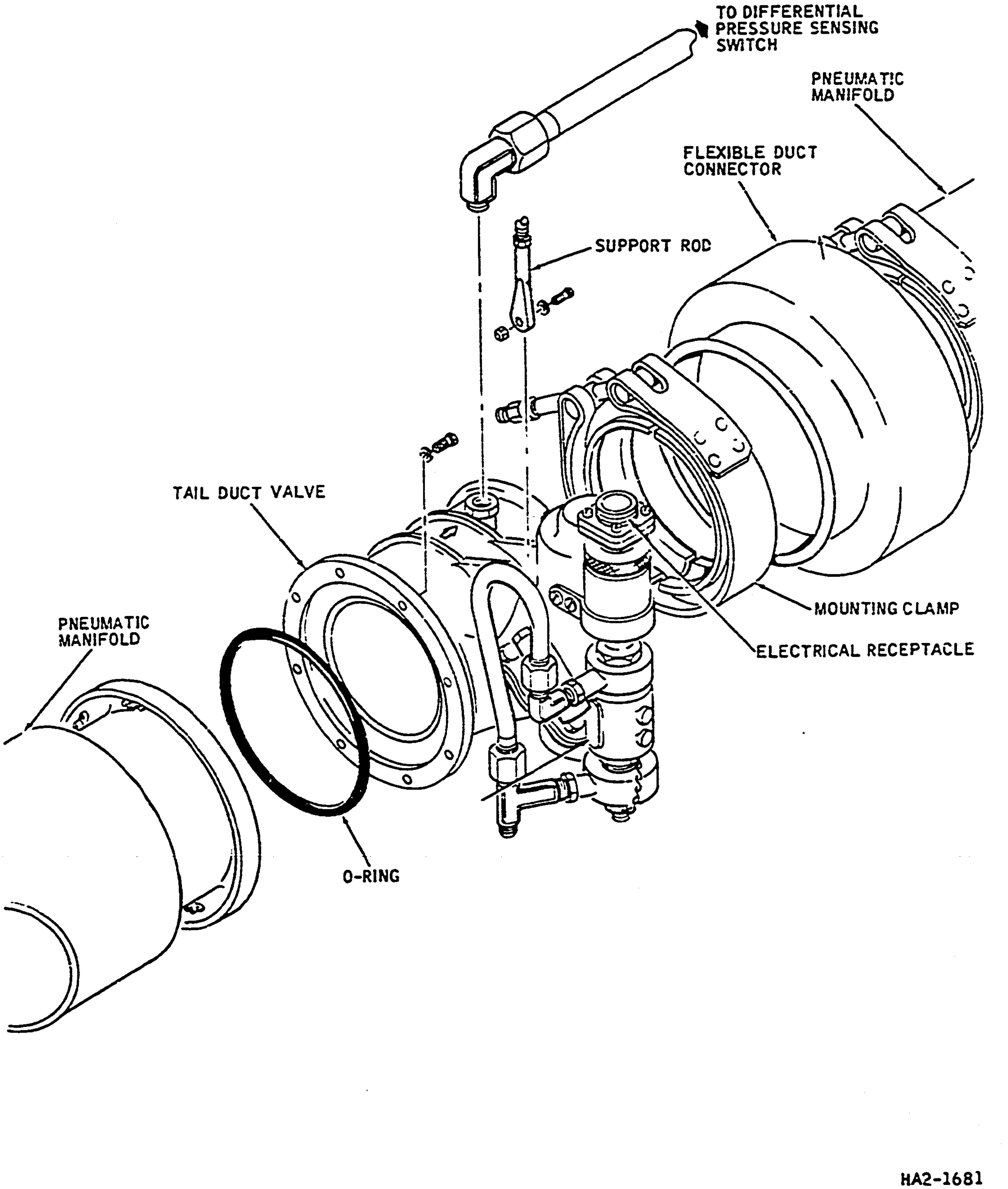
(1) Make certain that empennage deicing and warning circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel is open.

(2) Place new gasket on inlet end of tail duct valve.

(3) Position valve on tail duct and install attaching bolts.

(4) Tighten V-band connector at outlet end of valve to torque of 45 (±5) inch-pounds.

(5) Connect actuating air overboard vent line to valve.



Tail Duct Valve Installation
Figure 201

(6) Connect sense line to valve.

(7) Connect support rod to valve.

(8) Connect electrical connector to valve.

(9) Close empennage deicing and warning circuit breaker.

3. Adjustment/Test Tail Duct Valve

A. Test Tail Duct Valve

(1) Place following flight compartment controls in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter ignition switches	Off

(2) Connect pneumatic ground source and pressurize pneumatic manifold (see Chapter 36).

(3) Open left ground control relay circuit breaker located on miscellaneous dc bus section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(4) Make certain that tail duct valve switch is in normal position.

(5) Place airfoil deicing switch in No. 1 or No. 2 timer position. Tail deicing indicating light should come on due to relatively cool air surging through opened valve.

NOTE: Tail deicing indicating light may stay on for more than one cycle, but will go off when tail deicing system reaches normal operating temperature.

(6) Check by sound and feel for leaks in tail duct valve.

(7) Place airfoil deicing switch in off position.

(8) Close left ground control relay circuit breaker.

(9) Depressurize pneumatic manifold and disconnect pneumatic ground source (see Chapter 36).

TAIL DUCT VALVE - MAINTENANCE PRACTICES

1. General

A. The tail duct valve is installed in the forward end of the tail duct at the junction of the wing and fuselage sections of the pneumatic manifold. The valve, located at the aft end of the left tunnel area, is accessible through access door No. 13.

2. Removal/Installation Tail Duct Valves

A. Remove Tail Duct Valve

(1) Open empennage deicing and warning circuit breaker, located on heat, vent and ice protection section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Disconnect and cap electrical connector from tail duct valve.

(3) Disconnect support rod attached to valve.

(4) Disconnect and cap sense line from valve.

(5) Disconnect and cap actuating air overboard vent line from valve.

(6) Loosen flexible duct connector that attaches outlet end of valve to tail duct.

(7) Remove attaching bolts that connect inlet end of valve to tail duct and remove valve. Discard gasket.

CAUTION: COVER ALL OPEN PORTS AND LINES TO PREVENT ENTRANCE OF FOREIGN MATERIAL.

B. Install Tail Duct Valve

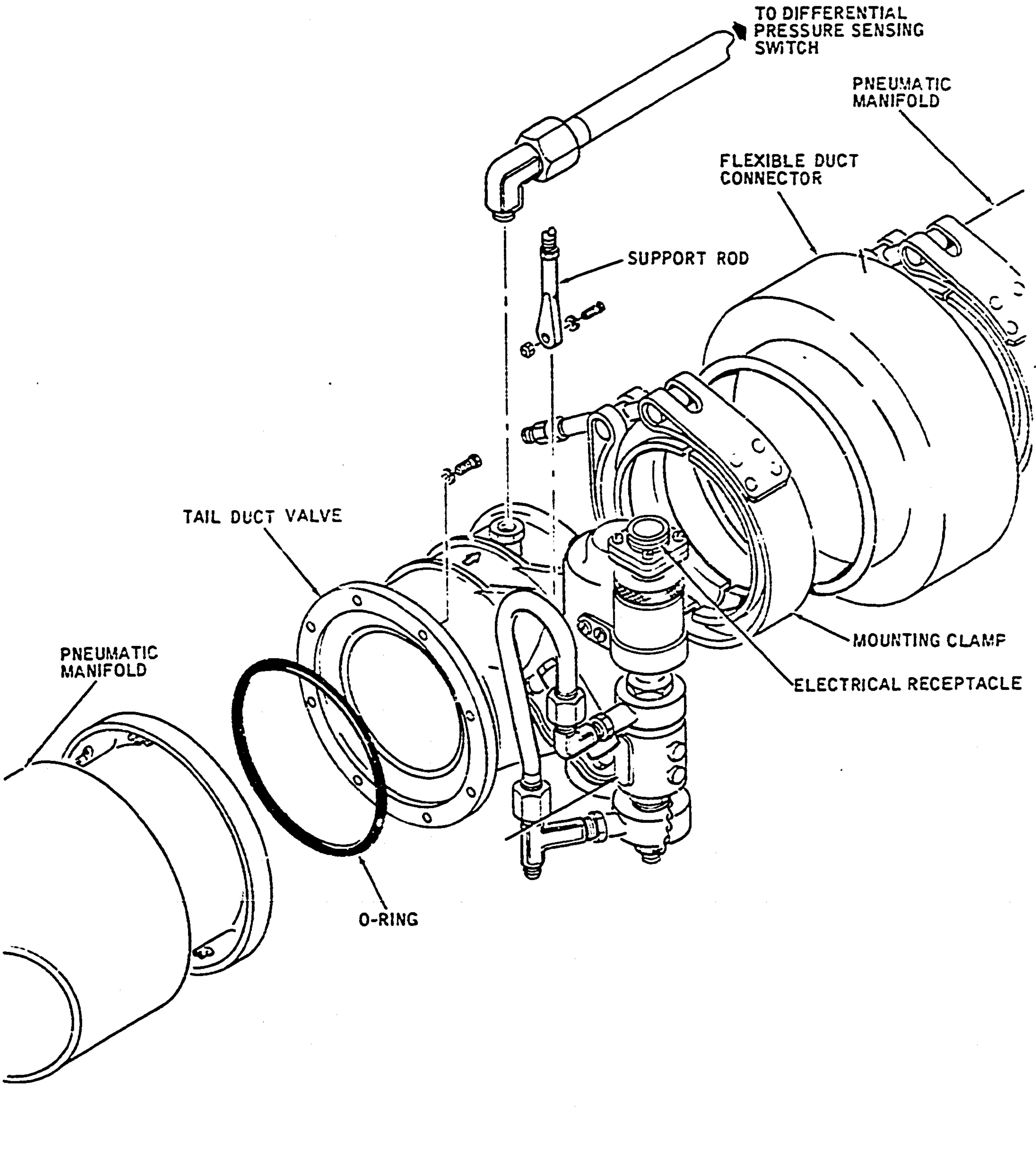
(1) Make certain that empennage deicing and warning circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel is open.

(2) Place new gasket on inlet end of tail duct valve.

(3) Position valve on tail duct and install attaching bolts.

(4) Tighten V-band connector at outlet end of valve to torque of 45 (±5) inch-pounds.

(5) Connect actuating air overboard vent line to valve.



Tail Duct Valve Installation
Figure 201

(6) Connect sense line to valve.

(7) Connect support rod to valve.

(8) Connect electrical connector to valve.

(9) Close empennage deicing and warning circuit breaker.

3. Adjustment/Test Tail Duct Valve

A. Test Tail Duct Valve

(1) Place following flight compartment controls in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing [illegible]ch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect pneumatic ground source and pressurize pneumatic manifold (see Chapter 36).

(3) Open right ground control relay circuit breaker located on miscellaneous section of EPC circuit breaker panel.

<u>WARNING</u>: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(4) Make certain that tail duct valve switch is in normal position.

(5) Place airfoil deicing switch in No. 1 or No. 2 timer position.

(6) Depress tail deice pushbutton. Tail deicing indicating light should come on until downstream duct pressure increases to normal differential pressure.

<u>NOTE</u>: Depressing the tail deice pushbutton initiates a 150 second cycle. If the pushbutton is reactuated during any part of the preceding cycle a new 150 second cycle begins.

(7) Check by sound and feel for leaks in tail duct valve.

(8) Place airfoil deicing switch in off position.

(9) Close right ground control relay circuit breaker.

(10) Depressurize pneumatic manifold and disconnect pneumatic ground source (see Chapter 36).

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TAIL DUCT VALVE - MAINTENANCE PRACTICES

1. General

A. The tail duct valve is installed in the forward end of the tail duct at the junction of the wing and fuselage sections of the pneumatic manifold. The valve, located at the aft end of the left tunnel area, is accessible through access door No. 13.

2. Removal/Installation Tail Duct Valves

A. Remove Tail Duct Valve

(1) Open empennage deicing and warning circuit breaker, located on heat, vent and ice protection section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Disconnect and cap electrical connector from tail duct valve.

(3) Disconnect support rod attached to valve.

(4) Disconnect and cap sense line from valve.

(5) Disconnect and cap actuating air overboard vent line from valve.

(6) Loosen flexible duct connector that attaches outlet end of valve to tail duct.

(7) Remove attaching bolts that connect inlet end of valve to tail duct and remove valve. Discard gasket.

CAUTION: COVER ALL OPEN PORTS AND LINES TO PREVENT ENTRANCE OF FOREIGN MATERIAL.

B. Install Tail Duct Valve

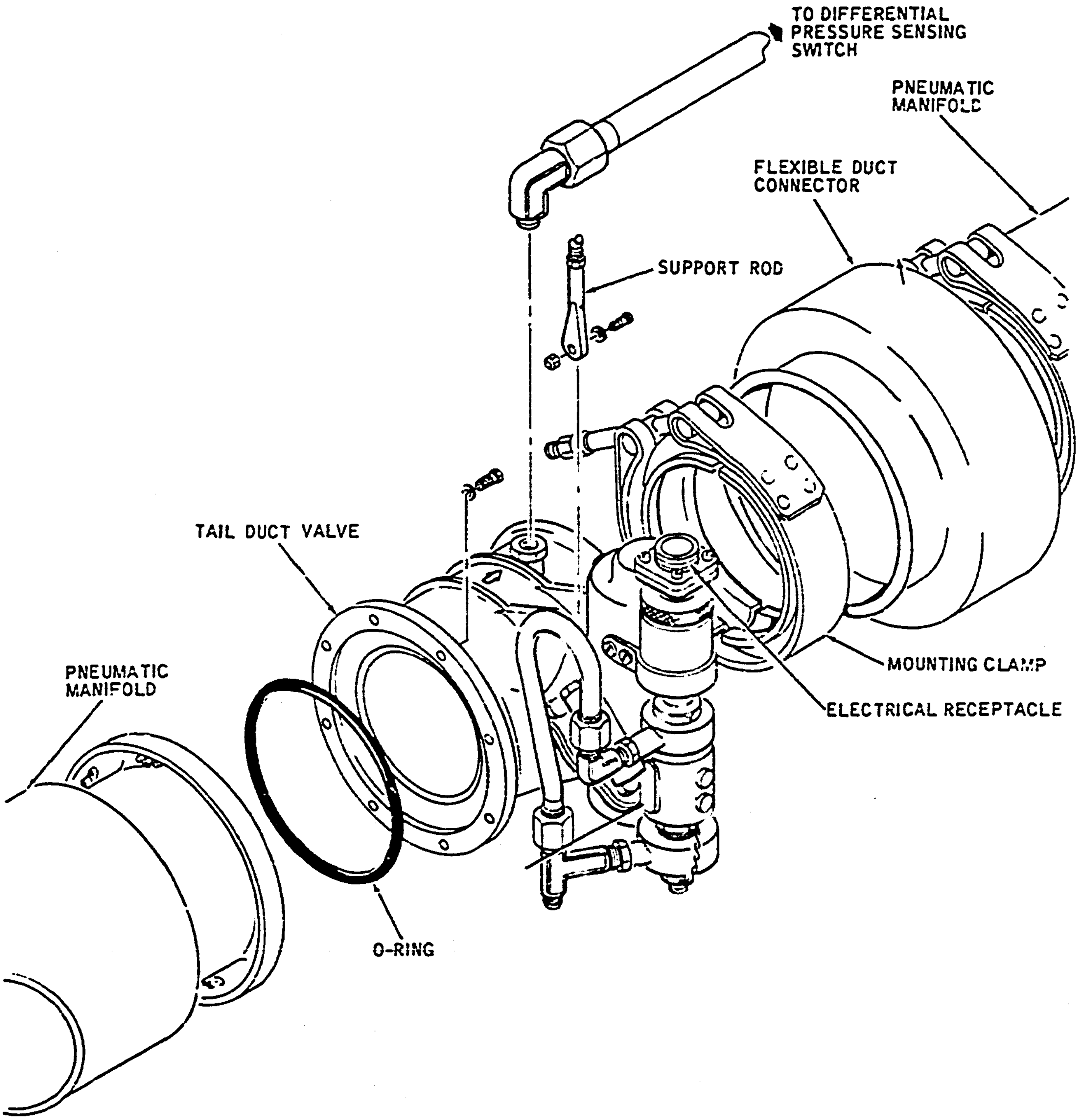
(1) Make certain that empennage deicing and warning circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel is open.

(2) Place new gasket on inlet end of tail duct valve.

(3) Position valve on tail duct and install attaching bolts.

(4) Tighten V-band connector at outlet end of valve to torque of 45 (±5) inch-pounds.

(5) Connect actuating air overboard vent line to valve.



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Tail Duct Valve Installation
Figure 201

(6) Connect sense line to valve.

(7) Connect support rod to valve.

(8) Connect electrical connector to valve.

(9) Close empennage deicing and warning circuit breaker.

3. Adjustment/Test Tail Duct Valve

A. Test Tail Duct Valve

(1) Place following flight compartment controls in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect pneumatic ground source and pressurize pneumatic manifold (see Chapter 36).

(3) On airplanes 801 - 822, open left ground control relay circuit breaker located on miscellaneous dc bus section of EPC circuit breaker panel. On airplanes 860 and subsequent, open right ground control relay circuit breaker.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUT-DOWN OF EQUIPMENT.

(4) Make certain that tail duct valve switch is in normal position.

(5) On airplanes 801 through 817 perform the following:

(a) Place airfoil deicing switch in No. 1 or No. 2 timer position.

(b) Place and hold tail duct valve test switch in test position. Tail deicing system indicating light should come on only when deicer timer is in positions No. 6, 8, 9, or 10.

(c) Place tail duct valve switch in off position. With tail duct test switch in test position, tail deicing system indicating light should remain off for all timer positions.

(d) Return tail duct valve switch to normal position. With tail duct valve test switch in off position, tail deicing system indicating light should be off.

(6) On airplanes 818 through 822 perform the following:

(a) Place airfoil deicing switch in No. 1 or No. 2 timer position. Tail deicing system indicating light should come on due to relatively cool air surging through opened valve.

NOTE: Indicating light may stay on for more than one complete timer cycle but should go off when the tail deicing system reaches normal operating temperature.

(7) On airplanes 860 and subsequent perform the following:

(a) Place airfoil deicing switch in No. 1 or No. 2 timer position.

(b) Press tail deice switch. Tail deicing system indicating light should come on during initial surge of air through opened valve.

NOTE: Pressing tail deice switch starts a 150-second cycle. If tail deice switch is pressed during a cycle a new 150-second cycle begins.

(c) After tail deice system indicating light goes off, place tail duct valve switch in off position, then in normal position. Tail deice system indicating light should come on momentarily.

(8) Place airfoil deicing switch in off position.

NOTE: On airplanes 860 and subsequent tail deice 150-second cycle should be completed before placing switch in off position.

(9) On airplanes 801 - 822, close left ground control relay circuit breaker. On airplanes 860 and subsequent, close right ground control relay circuit breaker.

(10) Depressurize pneumatic manifold and disconnect ground pneumatic source (see Chapter 36).

TAIL DUCT VALVE - MAINTENANCE PRACTICES

1. General

A. The tail duct valve is installed in the forward end of the tail duct at the junction of the wing and fuselage sections of the pneumatic manifold. The valve, located at the aft end of the left tunnel area, is accessible through access door No. 13.

2. Removal/Installation Tail Duct Valves

A. Remove Tail Duct Valve

(1) Open empennage deicing and warning circuit breaker, located on heat, vent and ice protection section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Disconnect and cap electrical connector from tail duct valve.

(3) Disconnect support rod attached to valve.

(4) Disconnect and cap sense line from valve.

(5) Disconnect and cap actuating air overboard vent line from valve.

(6) Loosen flexible duct connector that attaches outlet end of valve to tail duct.

(7) Remove attaching bolts that connect inlet end of valve to tail duct and remove valve. Discard gasket.

CAUTION: COVER ALL OPEN PORTS AND LINES TO PREVENT ENTRANCE OF FOREIGN MATERIAL.

B. Install Tail Duct Valve

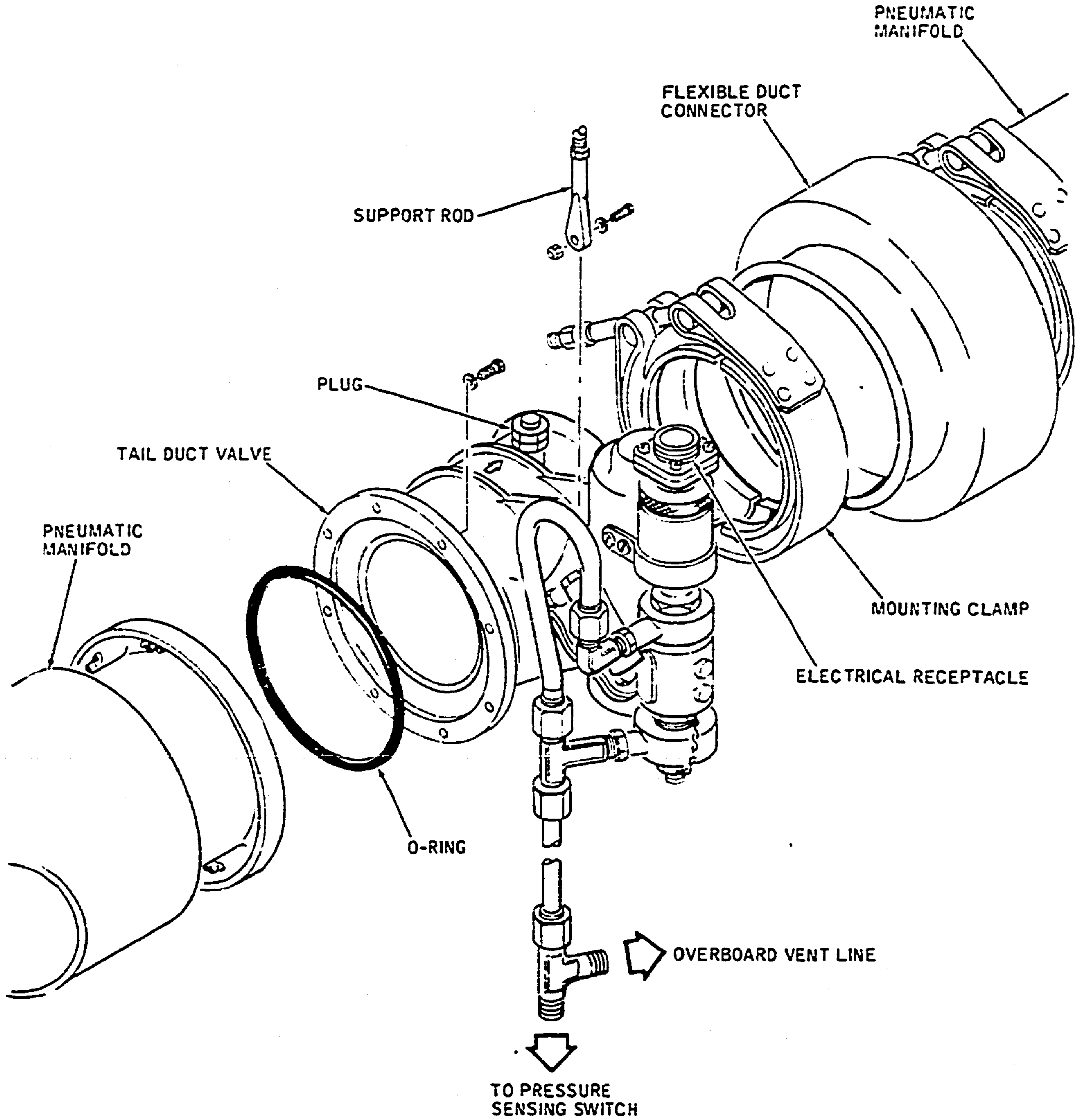
(1) Make certain that empennage deicing and warning circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel is open.

(2) Place new gasket on inlet end of tail duct valve.

(3) Position valve on tail duct and install attaching bolts.

(4) Tighten V-band connector at outlet end of valve to torque of 45 (±5) inch-pounds.

CAUTION: MAKE CERTAIN THAT PLUG IS INSTALLED AND TIGHTENED IN PORT LOCATED ON TOP OF VALVE (SEE FIGURE 201).



Tail Duct Valve Installation
Figure 201

(5) Connect actuating air overboard vent line to valve.

(6) Connect sense line to "T" on valve vent port (See Figure 201).

(7) Connect support rod to valve.

(8) Connect electrical connector to valve.

(9) Close empennage deicing and warning circuit breaker.

3. Adjustment/Test Tail Duct Valve

A. Test Tail Duct Valve

(1) Place following flight compartment controls in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect pneumatic ground source and pressurize pneumatic manifold (see Chapter 36).

(3) Open right ground control relay circuit breaker located on miscellaneous section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(4) Make certain that tail duct valve switch is in normal position.

(5) Place airfoil deicing switch in No. 1 or No. 2 timer position.

(6) Depress tail deice pushbutton. Tail deicing indicating light should come on until downstream duct pressure increases to normal differential pressure.

NOTE: Depressing the tail deice pushbutton initiates a 150 second cycle. If the pushbutton is reactuated during any part of the preceding cycle a new 150 second cycle begins.

(7) Check by sound and feel for leaks in tail duct valve.

(8) Place airfoil deicing switch in off position.

(9) Close right ground control relay circuit breaker.

(10) Depressurize pneumatic manifold and disconnect pneumatic ground source (see Chapter 36).

AIRFOIL DEICING VALVES - MAINTENANCE PRACTICES

1. General

A. The airfoil deicing valves are located in the outer wings, center wings, inner wings, and horizontal stabilizer. Access to the deicing valves is as follows.

Component	Valve Number	Access Door
Outer Wing Valve	1	518A
Outer Wing Valve	3	519A
Outer Wing Valve	5	519C
Center Wing Valve	7	522A
Center Wing Valves	2 & 4	522B
Inner Wing Valves	6 & 8	520D
Horizontal Stabilizer Valves	2 & 4	64A
Horizontal Stabilizer Valves	6 & 8	64D
Horizontal Stabilizer Valves	9 & 10	64H

B. The removal and installation procedures for all 18 airfoil deicing valves are identical. The valves located in the horizontal stabilizer and outer wing sections are of a different type than the valves installed in the center and inner wing sections, and are not interchangeable.

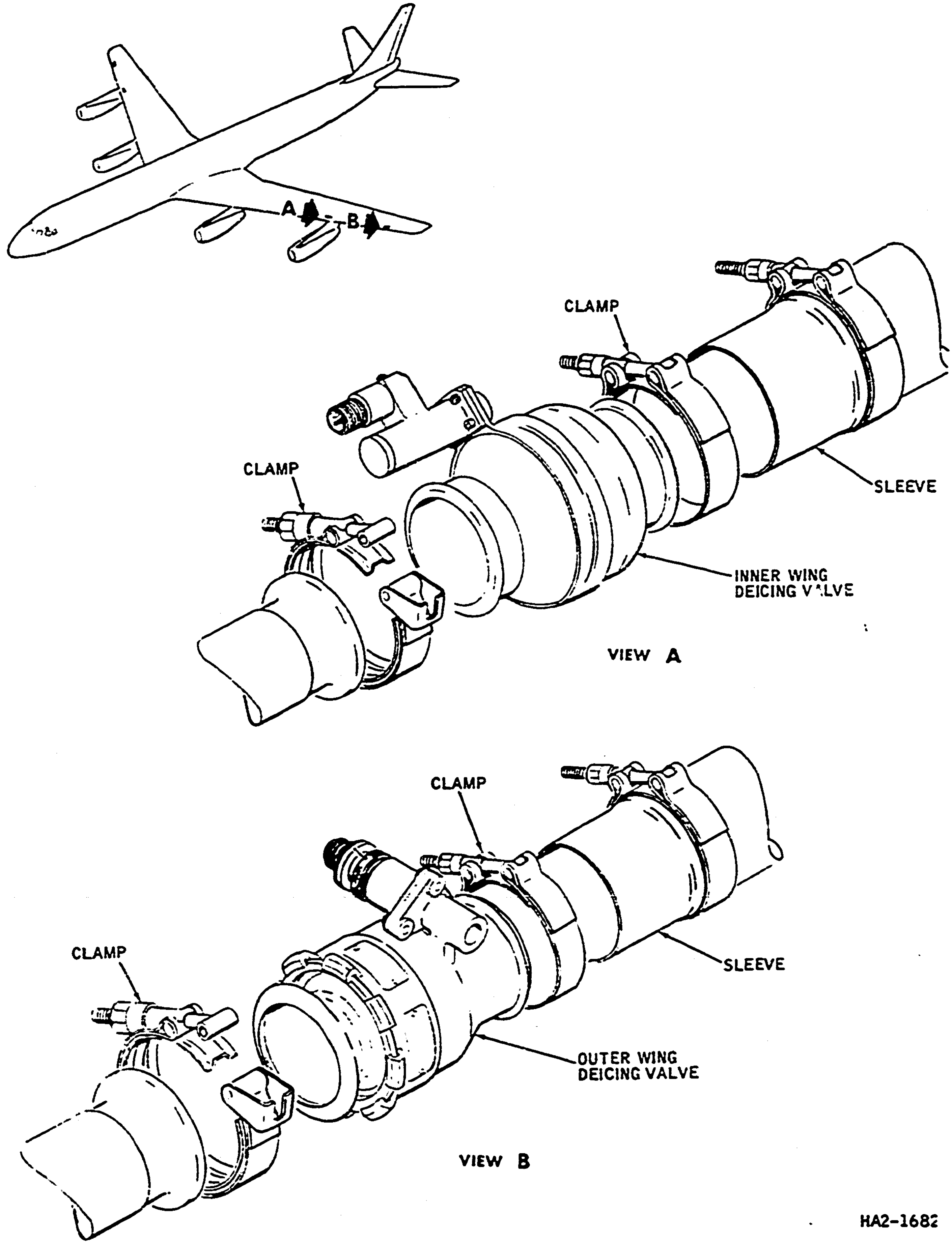
2. Removal/Installation Airfoil Deicing Valves

A. Remove Deicing Valve

(1) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Disconnect and cap electrical connector from airfoil deicing valve.



Airfoil Deicing Valves -- Installation
Figure 201

(3) Loosen clamp securing valve to D-duct.

(4) Loosen clamp securing valve to bleed air manifold, and remove valve.

CAUTION: PROTECT OPEN PORTS AND LINES WITH PLASTIC CAPS. KEEP CAPS IN CLEAN CONTAINERS WHEN NOT IN USE.

B. Install Deicing Valve

(1) Make certain that airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of EPC circuit breaker panel, is open.

(2) Position airfoil deicing valve between bleed air manifold and D-duct.

(3) Tighten clamp at bleed air manifold to torque of 45 (±5) inch-pounds.

(4) Tighten clamp at D-duct to torque of 25 to 30 inch-pounds.

(5) Connect electrical connector to valve.

(6) Close airfoil deicing valves circuit breaker.

3. Adjustment/Test Airfoil Deicing Valves

A. Functional and leak tests of the airfoil deicing system are performed in 30-10-0, Maintenance Practices.

AIRFOIL DEICING VALVES - MAINTENANCE PRACTICES

1. General

A. The airfoil deicing valves are located in the outer wings, center wings, and inner wings. Access to the deicing valves is as follows.

Component	Valve Number	Access Door
Outer Wing Valve	6	518A
Outer Wing Valve	3	519A
Outer Wing Valve	5	519C
Center Wing Valve	7	522A
Center Wing Valves	2 & 4	522B
Inner Wing Valves	8	520D

B. The removal and installation procedures for all 12 airfoil deicing valves are identical. The valves located in the outer wing sections are of a different type than the valves installed in the center and inner wing sections, and are not interchangeable.

2. Removal/Installation Airfoil Deicing Valves

A. Remove Deicing Valve

(1) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of EPC circuit breaker panel.

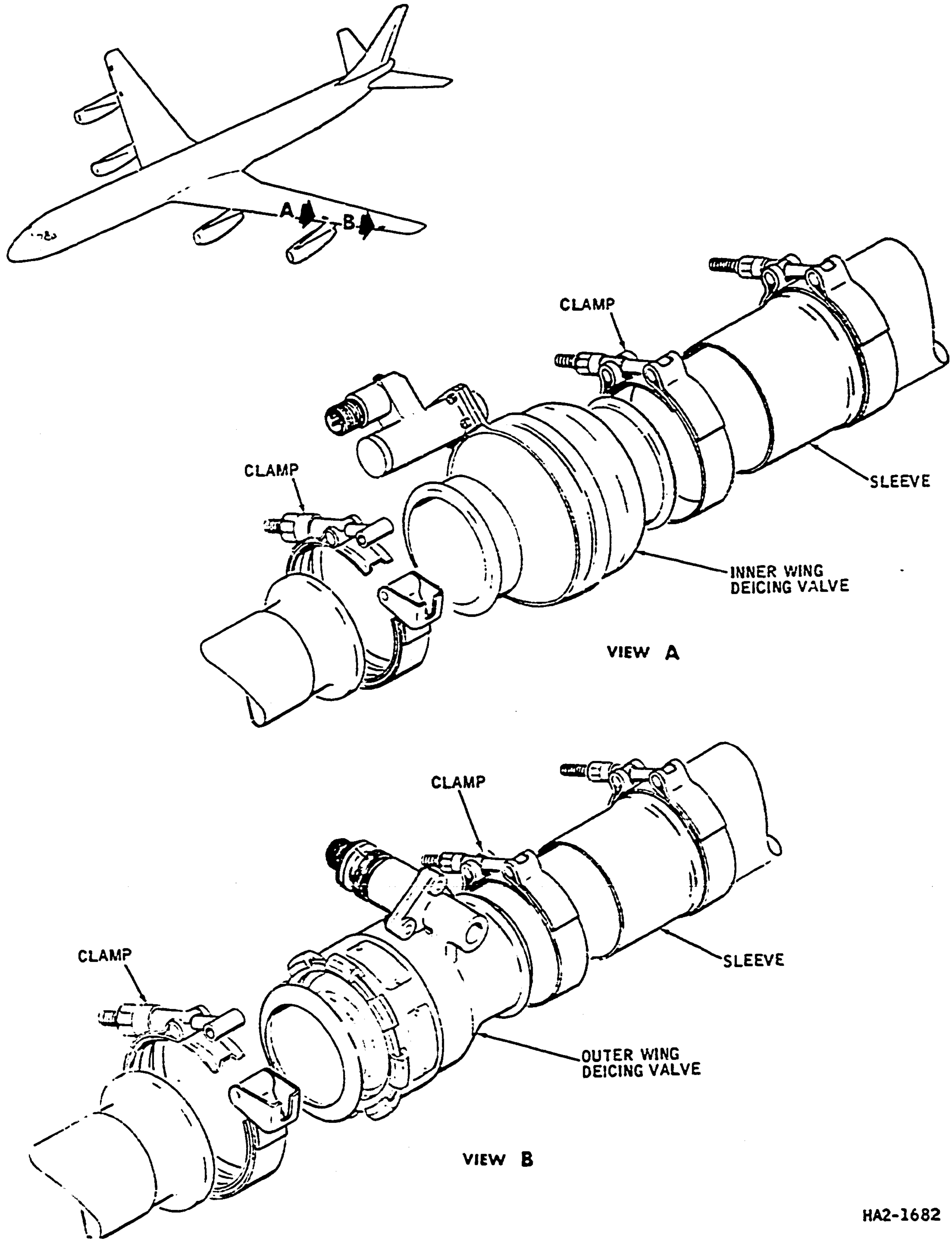
WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Disconnect and cap electrical connector from airfoil deicing valve.

(3) Loosen clamp securing valve to D-duct.

(4) Loosen clamp securing valve to bleed air manifold and remove valve.

CAUTION: PROTECT OPEN PORTS AND LINES WITH PLASTIC CAPS. KEEP CAPS IN CLEAN CONTAINERS WHEN NOT IN USE.



Airfoil Deicing Valves -- Installation
Figure 201

B. Install Deicing Valve

(1) Make certain that airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of EPC circuit breaker panel, is open.

(2) Position airfoil deicing valve between bleed air manifold and D-duct.

(3) Tighten clamp at bleed air manifold to torque of 45 (±5) inch-pounds.

(4) Tighten clamp at D-duct to torque of 25 to 30 inch-pounds.

(5) Connect electrical connector to valve.

(6) Close airfoil deicing valves circuit breaker.

3. Adjustment/Test Airfoil Deicing Valves

A. Functional and leak tests of the airfoil deicing systems are performed in 30-10-0, Maintenance Practices.

AIRFOIL DEICING VALVES - MAINTENANCE PRACTICES

1. General

A. The airfoil deicing valves are located in the outer wings, center wings, inner wings, and empennage. Access to the deicing valves is as follows.

Component	Valve Number	Access Door
Outer Wing Valve	1	518A
Outer Wing Valve	3	519A
Outer Wing Valve	5	519C
Center Wing Valve	7	522A
Center Wing Valves	2 & 4	522B
Inner Wing Valves	6 & 8	520D
Inner Wing Valves (801-804)	9 & 10	520E
Inner Wing Valves (801-804)	11 & 12	520G
Horizontal Stabilizer Valves (801-819)	2 & 4	64A
Horizontal Stabilizer Valves (801-819)	6 & 8	64D
Horizontal Stabilizer Valves (801-819)	9 & 10	64H

B. The removal and installation procedures for all airfoil deicing valves are identical. The valves located in the empennage and outer wing sections are of a different type than the valves installed in the center and inner wing sections, and are not interchangeable.

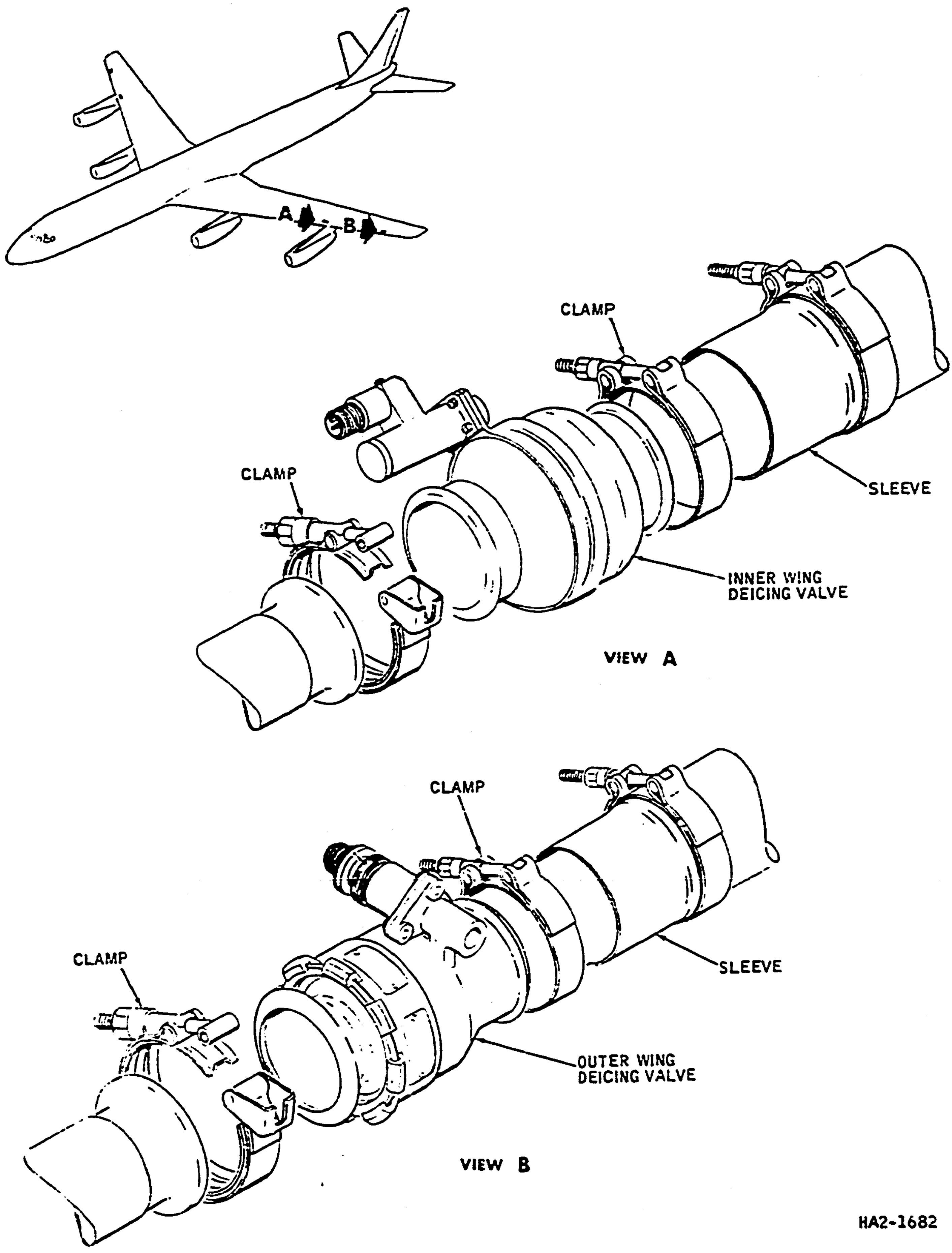
2. Removal/Installation Airfoil Deicing Valves

A. Remove Deicing Valve

(1) Open airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

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Airfoil Deicing Valves -- Installation
Figure 201

(2) Disconnect and cap electrical connector from airfoil deicing valve.

(3) Loosen clamp securing valve to D-duct.

(4) Loosen clamp securing valve to bleed air manifold, and remove valve.

CAUTION: PROTECT OPEN PORTS AND LINES WITH PLASTIC CAPS. KEEP CAPS IN CLEAN CONTAINERS WHEN NOT IN USE.

B. Install Deicing Valve

(1) Make certain that airfoil deicing valves circuit breaker, located on heat, vent and ice protection (dc bus) section of EPC circuit breaker panel, is open.

(2) Position airfoil deicing valve between bleed air manifold and D-duct.

(3) Tighten clamp at bleed air manifold to torque of 45 (±5) inch-pounds.

(4) Tighten clamp at D-duct to torque of 25 to 30 inch-pounds.

(5) Connect electrical connector to valve.

(6) Close airfoil deicing valves circuit breaker.

3. Adjustment/Test Airfoil Deicing Valves

A. Functional and leak tests of the airfoil deicing system are performed in 30-10-0, Maintenance Practices.

AIRFOIL DEICING TIMERS - MAINTENANCE PRACTICES

1. General

A. The airfoil deicing timers are located in the flight compartment on the systems engineer's control panel. The maintenance procedures for both airfoil deicing timers are identical.

2. Removal/Installation Airfoil Deicing Timer

A. Remove Timer

(1) Open following applicable circuit breakers located on EPC circuit breaker panel.

Circuit Breaker	Panel Section
Airfoil deicing timer (1 or 2)	Heat, vent, and ice protection (ac buses)
Airfoil deicing valves	Heat, vent, and ice protection (dc bus)
Empennage deicing and warning	Heat, vent and ice protection (dc bus)
Flight engineer's panel integral lighting	Lighting (ac buses)

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

(2) Loosen fillister-head screw securing timer to systems engineer's panel, and remove timer.

(3) Disconnect and cap electrical connector from timer.

B. Install Timer

(1) Make certain following applicable circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Airfoil deicing timer (1 or 2)	Heat, vent, and ice protection (ac buses)
Airfoil deicing valves	Heat, vent, and ice protection (dc bus)

Circuit Breaker	Panel Section
Empennage deicing and warning	Heat, vent and ice protection (dc bus)
Flight engineer's panel integral lighting	Lighting (ac buses)

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

(2) Connect electrical connector to airfoil deicing timer.

(3) Insert timer in systems engineer's control panel and tighten fillister-head screw.

(4) Close following applicable circuit breakers

Circuit Breaker	Panel Section
Airfoil deicing timer (1 or 2)	Heat, vent, and ice protection (ac buses)
Airfoil deicing valves	Heat, vent, and ice protection (dc bus)
Empennage deicing and warning	Heat, vent and ice protection (dc bus)
Flight engineer's panel integral lighting	Lighting (ac buses)

3. Adjustment/Test Airfoil Deicing Timer

A. Adjustment/Test of the airfoil deicing timer is performed in 30-10-0, Maintenance Practices.

AIRFOIL DEICING TIMERS - MAINTENANCE PRACTICES

1. General

   A. The airfoil deicing timers are located in the flight compartment on the systems engineer's control panel. The maintenance procedures for both airfoil deicing timers are identical.

2. Removal/Installation Airfoil Deicing Timer

   A. Remove Timer

      (1) Open following applicable circuit breakers located on EPC circuit breaker panel.

Circuit Breaker	Panel Section
Airfoil deicing timer (1 or 2)	Heat, vent, and ice protection (ac buses)
Airfoil deicing valves	Heat, vent, and ice protection (dc bus)
Flight engineer's panel integral lighting	Lighting (ac buses)

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

      (2) Loosen fillister-head screw securing timer to systems engineer's panel, and remove timer.

      (3) Disconnect and cap electrical connector from timer.

B. Install Timer

(1) Make certain following applicable circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Airfoil deicing timer (1 or 2)	Heat, vent, and ice protection (ac buses)
Airfoil deicing valves	Heat, vent, and ice protection (dc bus)
Flight engineer's panel integral lighting	Lighting (ac buses)

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

(2) Connect electrical connector to airfoil deicing timer.

(3) Insert timer in systems engineer's control panel and tighten fillister-head screw.

(4) Close following applicable circuit breakers.

Circuit Breaker	Panel Section
Airfoil deicing timer (1 or 2)	Heat, vent, and ice protection (ac buses)
Airfoil deicing valves	Heat, vent, and ice protection (dc bus)
Flight engineer's panel integral lighting	Lighting (ac buses)

3. Adjustment/Test Airfoil Deicing Timer

A. Adjustment/Test of the airfoil deicing timer is performed in 30-10-0, Maintenance Practices.

TAIL DUCT VENTURI DIFFERENTIAL-PRESSURE SWITCH - MAINTENANCE PRACTICES

1. General

   A. The tail duct venturi differential-pressure switch is installed just downstream of the tail duct valve, connected to the venturi. The switch, located at the aft end of the tunnel area, is accessible through access door 13.

2. Removal/Installation Tail Duct Venturi Differential-Pressure Switch

   A. Remove Pressure Switch

      (1) Open empennage deicing and warning circuit breaker, located on heat, vent and ice protection dc bus section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Disconnect and cap sense lines attached to high- and low-pressure ports of tail duct venturi differential-pressure switch.

      (3) Disconnect and cap electrical connector from switch.

      (4) Remove switch from support bracket.

      (5) Remove fittings from switch. Discard O-ring.

   B. Install Pressure Switch

      (1) Make certain empennage deicing and warning circuit breaker is open.

      (2) Using new O-rings, install fittings on switch.

      (3) Install tail duct venturi differential-pressure switch on support bracket.

      (4) Connect electrical connector to switch.

      (5) Make certain that there are no burrs present around pressure-sensing holes in throat of venturi duct assembly.

      (6) Connect sense lines to applicable port on switch.

      NOTE: Connect line from venturi to low-pressure port; connect line from surge chamber to high-pressure port.

      (7) Close empennage deicing and warning circuit breaker.

3. Adjustment/Test Tail Duct Venturi Differential-Pressure Switch

A. Test Pressure Switch

(1) Place following flight compartment controls and switches in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect ground pneumatic source and pressurize pneumatic manifold. (See Chapter 36.)

(3) Open left ground control relay circuit breaker located on miscellaneous dc bus section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(4) Make certain that tail duct valve switch is in normal position.

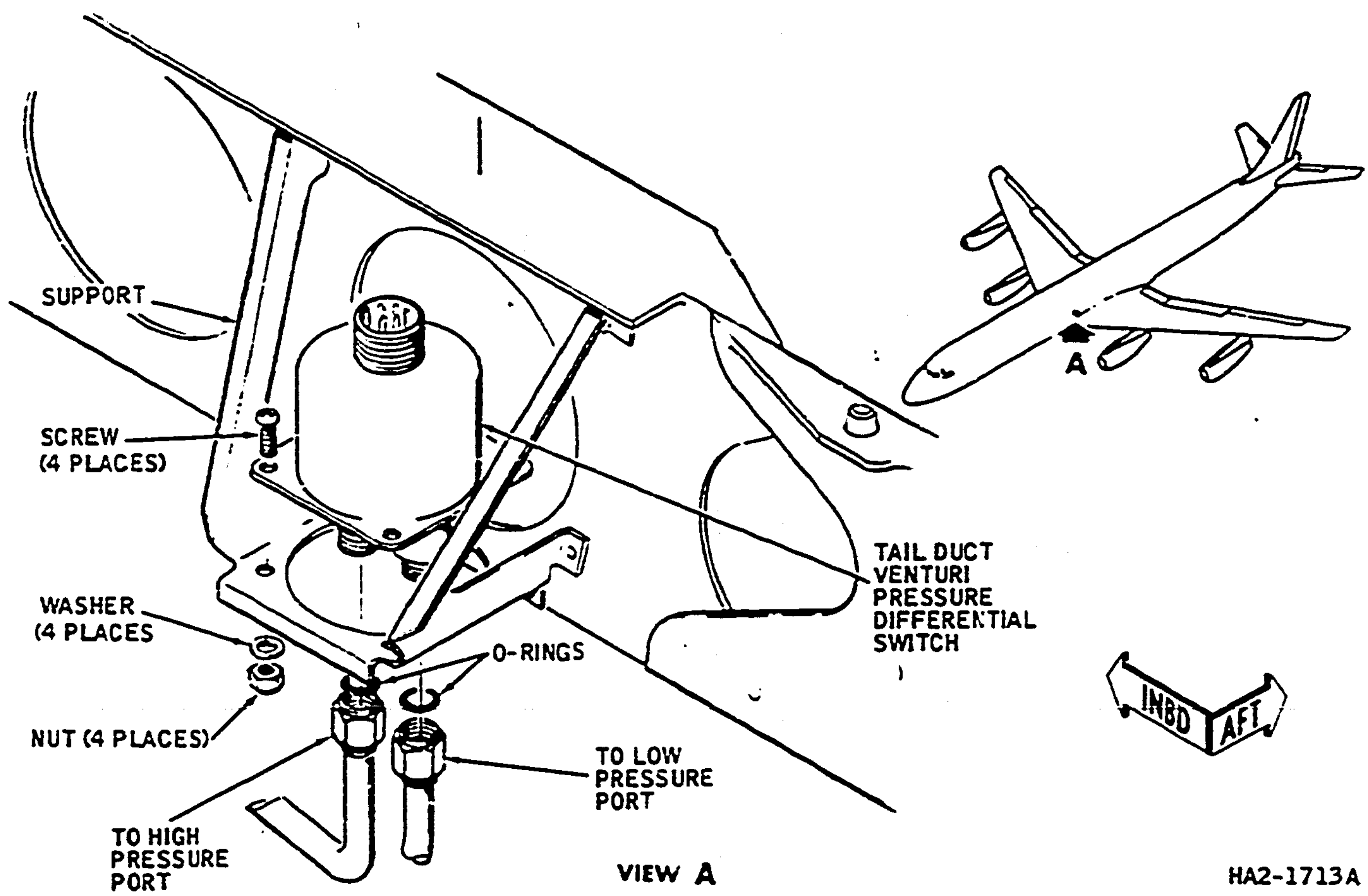
(5) Place airfoil deicing switch in No. 1 or No. 2 timer position. Tail deicing indicating light should come on due to relatively cool air surging through opened valve.

NOTE: Tail deicing indicating light may stay on for more than one cycle, but will go off when tail deicing system reaches normal operating temperature.

(6) Depressurize pneumatic manifold and disconnect ground pneumatic source. (See chapter 36.)

(7) Place airfoil deicing switch in off position.

(8) Close left ground control relay circuit breaker.



Tail Duct Venturi Differential --
Pressure Switch Installation
Figure 201

TAIL DUCT VENTURI DIFFERENTIAL-PRESSURE SWITCH - MAINTENANCE PRACTICES

1. General

A. The tail duct venturi differential-pressure switch is installed just downstream of the tail duct valve, connected to the venturi. The switch, located at the aft end of the tunnel area, is accessible through access door 13.

2. Removal/Installation Tail Duct Venturi Differential-Pressure Switch

A. Remove Pressure Switch

(1) Open empennage deicing and warning circuit breaker, located on heat, vent and ice protection dc bus section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Disconnect and cap sense lines attached to high- and low-pressure ports of tail duct venturi differential-pressure switch.

(3) Disconnect and cap electrical connector from switch.

(4) Remove switch from support bracket.

(5) Remove fittings from switch. Discard O-ring.

B. Install Pressure Switch

(1) Make certain empennage deicing and warning circuit breaker is open.

(2) Using new O-rings, install fittings on switch.

(3) Install tail duct venturi differential-pressure switch on support bracket.

(4) Connect electrical connector to switch.

(5) Make certain that there are no burrs present around pressure-sensing holes in throat of venturi duct assembly.

(6) Connect sense lines to applicable port on switch.

NOTE: Connect line from venturi to low-pressure port; connect line from surge chamber to high-pressure port.

(7) Close empennage deicing and warning circuit breaker.

3. Adjustment/Test Tail Duct Venturi Differential-Pressure Switch

A. Test Pressure Switch

(1) Place following flight compartment controls and switches in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect ground pneumatic source and pressurize pneumatic manifold. (See Chapter 36.)

(3) Open left ground control relay circuit breaker located on miscellaneous dc bus section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(4) Make certain that tail duct valve switch is in normal position.

(5) Place airfoil deicing switch in No. 1 or No. 2 timer position.

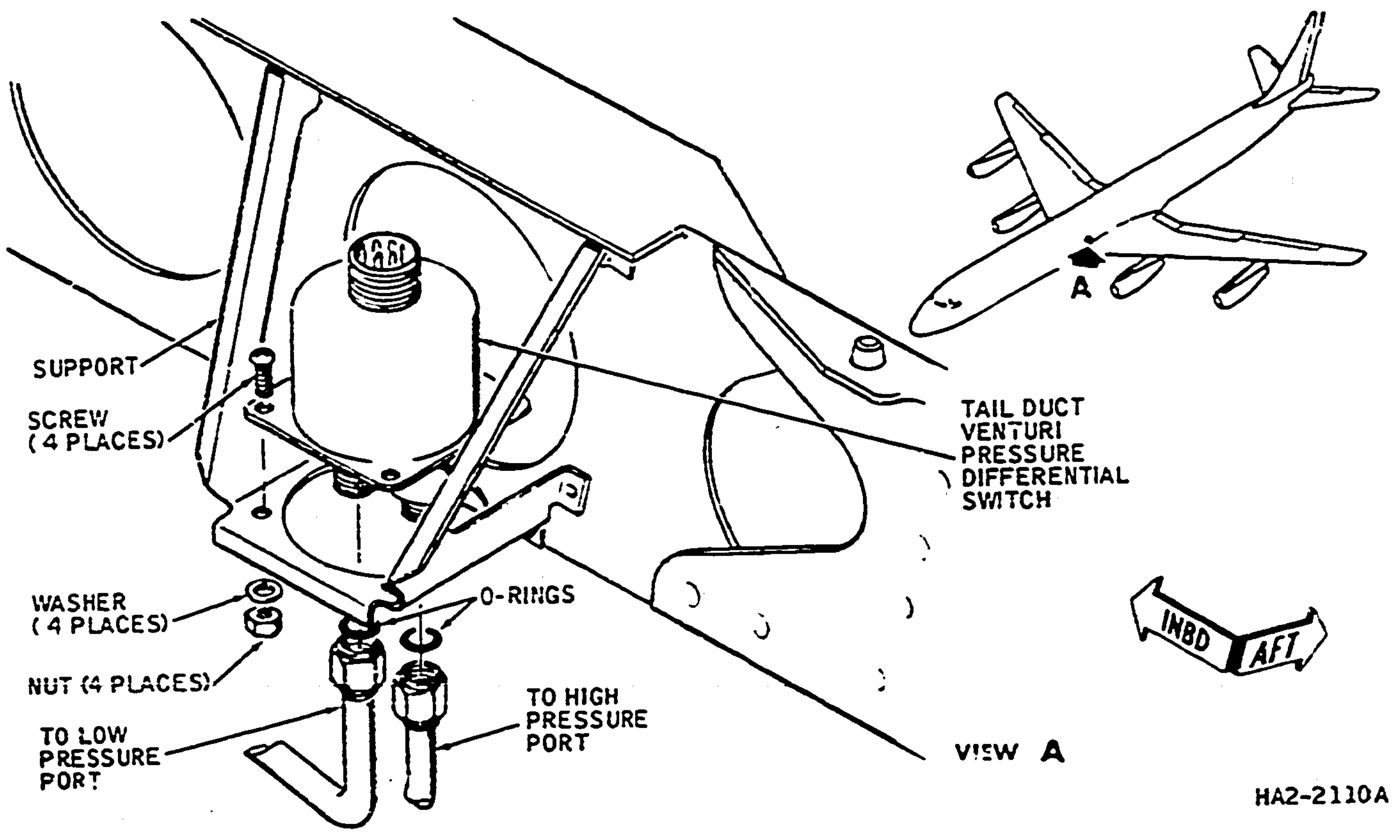
(6) Depress tail deice switch. Tail deicing indicating light should come on until downstream duct pressure increases and opens contacts in differential pressure switch.

NOTE: Depressing tail deice switch starts 150-second cycle. If tail deice switch is depressed during a cycle a new 150-second cycle begins.

(7) Depressurize pneumatic manifold and disconnect ground pneumatic source. (See chapter 36.)

(8) Place airfoil deicing switch in off position.

(9) Close left ground control relay circuit breaker.



Tail Duct Venturi Differential --
Pressure Switch Installation
Figure 201

TAIL DUCT VENTURI DIFFERENTIAL-PRESSURE SWITCH - MAINTENANCE PRACTICES

1. General

   A. The tail duct venturi differential-pressure switch is installed just downstream of the tail duct valve, connected to the venturi. The switch, located at the aft end of the tunnel area, is accessible through access door 13.

2. Removal/Installation Tail Duct Venturi Differential-Pressure Switch

   A. Remove Pressure Switch

      (1) Open empennage deicing and warning circuit breaker, located on heat, vent and ice protection dc bus section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Disconnect and cap sense lines attached to high- and low-pressure ports of tail duct venturi differential-pressure switch.

      (3) Disconnect and cap electrical connector from switch.

      (4) Remove switch from support bracket.

      (5) Remove fittings from switch. Discard O-ring.

   B. Install Pressure Switch

      (1) Make certain empennage deicing and warning circuit breaker is open.

      (2) Using new O-rings, install fittings on switch.

      (3) Install tail duct venturi differential-pressure switch on support bracket.

      (4) Connect electrical connector to switch.

      (5) Make certain that there are no burrs present around pressure-sensing holes in throat of venturi duct assembly.

      (6) Connect sense lines to applicable port on switch.

      NOTE: Connect line from venturi to low-pressure port; connect line from surge chamber to high-pressure port.

      (7) Close empennage deicing and warning circuit breaker.

3. Adjustment/Test Tail Duct Venturi Differential-Pressure Switch

A. Test Pressure Switch

(1) Place following flight compartment controls and switches in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect ground pneumatic source and pressurize pneumatic manifold. (See Chapter 36.)

(3) Open left ground control relay circuit breaker located on miscellaneous dc bus section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(4) Make certain that tail duct valve switch is in normal position.

(5) On airplanes 801 through 817 perform the following:

(a) Place airfoil deicing switch in No. 1 or No. 2 timer position.

(b) Place and hold tail duct valve test switch in test position. Tail deicing system indicating light should come on only when deicer timer is in positions No. 6, 8, 9, or 10.

(c) Place tail duct valve switch in off position. With tail duct test switch in test position, tail deicing system indicating light should remain off for all timer positions.

(d) Return tail duct valve switch to normal position. With tail duct valve test switch in off position, tail deicing system indicating light should be off.

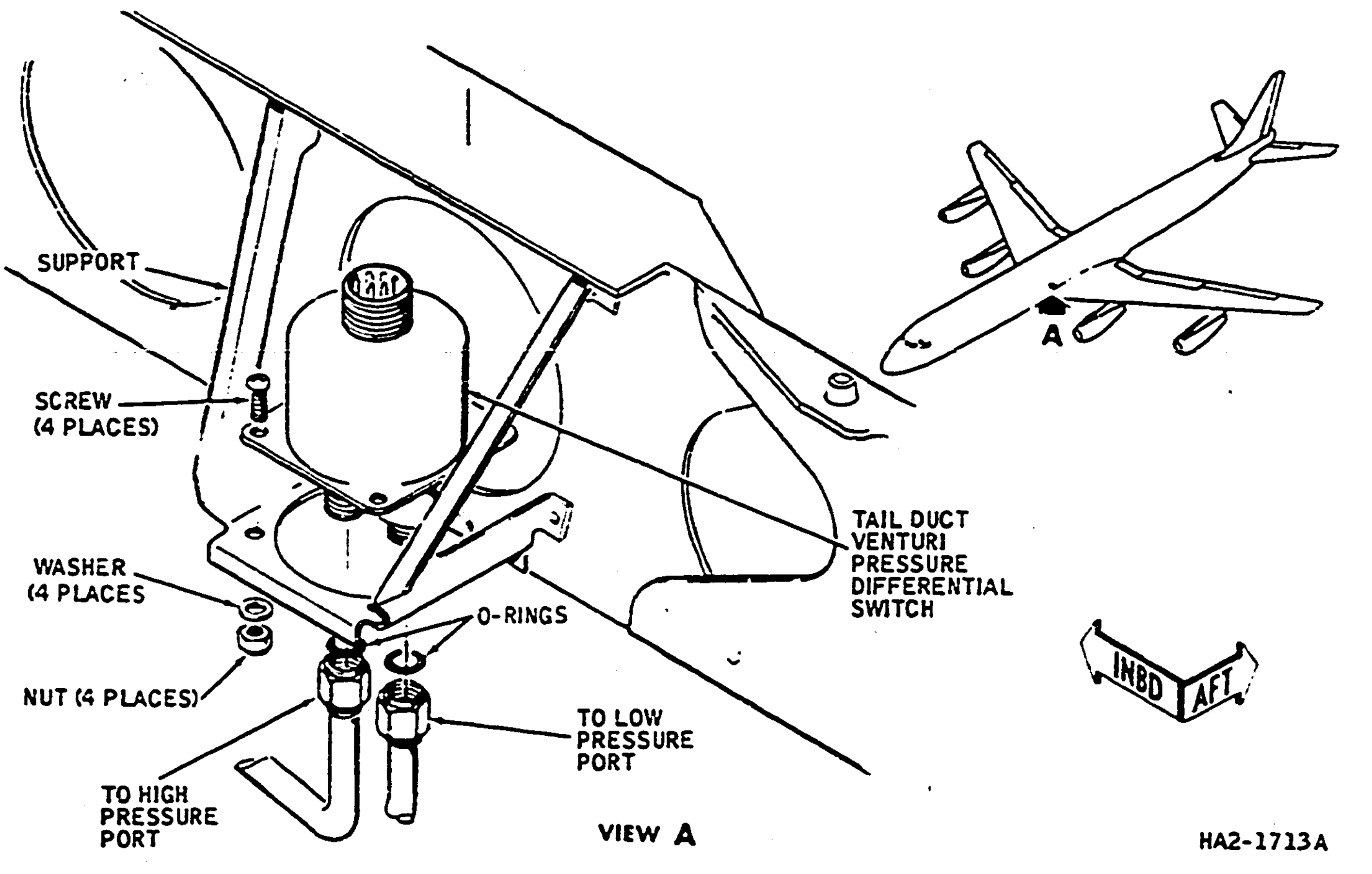
(6) On airplanes 818 through 822 perform the following:

(a) Place airfoil deicing switch in No. 1 or No. 2 timer position. Tail deicing system indicating light should come on due to relatively cool air surging through opened valve.

NOTE: Indicating light may stay on for more than one complete timer cycle but should go off when the tail deicing system reaches normal operating temperature.

(7) On airplanes 860 and subsequent perform the following:

(a) Place airfoil deicing switch in No. 1 or No. 2 timer position.



Tail Duct Venturi Differential -- Pressure Switch Installation
Figure 201

(b) Press tail deice switch. Tail deicing system indicating light should come on during initial surge of air through opened valve.

NOTE: Pressing tail deice switch starts a 150-second cycle. If tail deice switch is pressed during a cycle a new 150-second cycle begins.

(c) After tail deice system indicating light goes off, place tail duct valve switch in off position, then in normal position. Tail deice system indicating light should come on momentarily.

(8) Place airfoil deicing switch in off position.

NOTE: On airplanes 860 and subsequent tail deice 150-second cycle should be completed before placing switch in off position.

(9) Close left ground control relay circuit breaker.

(10) Depressurize pneumatic manifold and disconnect ground pneumatic source (see Chapter 36).

TAIL DUCT VENTURI DIFFERENTIAL-PRESSURE SWITCH - MAINTENANCE PRACTICES

1. General

A. The tail duct venturi differential-pressure switch is installed just downstream of the tail duct valve, connected to the venturi. The switch, located at the aft end of the tunnel area, is accessible through access door 13.

2. Removal/Installation Tail Duct Venturi Differential-Pressure Switch

A. Remove Pressure Switch

(1) Open empennage deicing and warning circuit breaker, located on heat, vent and ice protection dc bus section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Disconnect and cap sense lines attached to high- and low-pressure ports of tail duct venturi differential-pressure switch.

(3) Disconnect and cap electrical connector from switch.

(4) Remove switch from support bracket.

(5) Remove fittings from switch. Discard O-ring.

B. Install Pressure Switch

(1) Make certain empennage deicing and warning circuit breaker is open.

(2) Using new O-rings, install fittings on switch.

(3) Install tail duct venturi differential-pressure switch on support bracket.

(4) Connect electrical connector to switch.

(5) Make certain that there are no burrs present around pressure-sensing holes in throat of venturi duct assembly.

(6) Connect sense lines to applicable port on switch.

NOTE: Connect line from venturi to high-pressure port; connect line from valve vent line to low-pressure port.

(7) Close empennage deicing and warning circuit breaker.

3. Adjustment/Test Tail Duct Venturi Differential-Pressure Switch

A. Test Pressure Switch

(1) Place following flight compartment controls and switches in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect ground pneumatic source and pressurize pneumatic manifold. (See Chapter 36.)

(3) Open left ground control relay circuit breaker located on miscellaneous dc bus section of EPC circuit breaker panel.

WARNING: NORMAL ELECTRICAL POWER SUPPLY TO VARIOUS SYSTEMS IS INTERRUPTED WHEN GROUND CONTROL CIRCUIT BREAKERS ARE OPENED. MAKE CERTAIN THAT SWITCHES AND CONTROLS OF AFFECTED SYSTEMS ARE IN CORRECT POSITIONS TO PREVENT INADVERTENT OPERATION OR SHUTDOWN OF EQUIPMENT.

(4) Make certain that tail duct valve switch is in normal position.

(5) Place airfoil deicing switch in No. 1 or No. 2 timer position.

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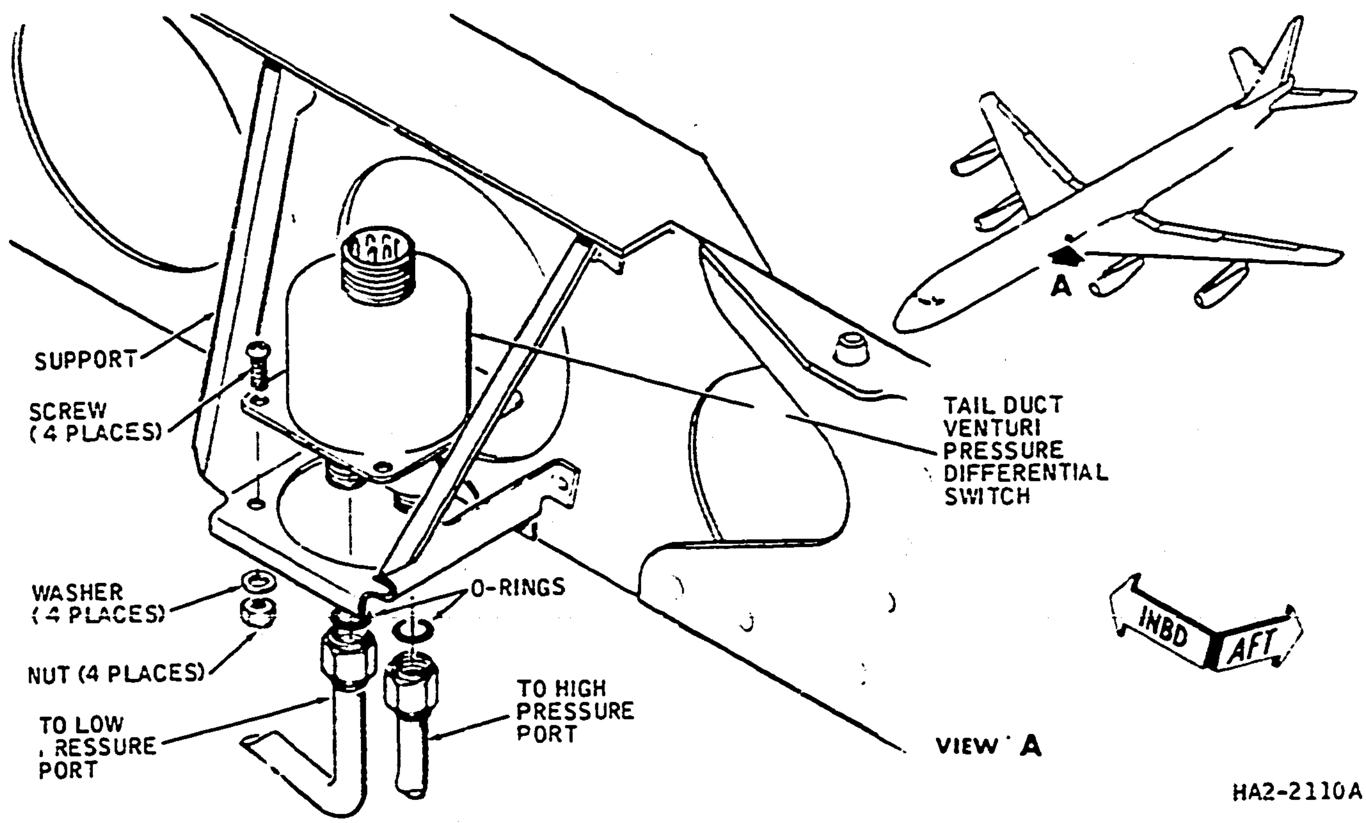
(6) Depress tail deice switch. Tail deicing indicating light should come on until downstream duct pressure increases and opens contacts in differential pressure switch.

NOTE: Depressing tail deice switch starts 150-second cycle. If tail deice switch is depressed during a cycle a new 150-second cycle begins.

(7) Depressurize pneumatic manifold and disconnect ground pneumatic source. (See Chapter 36.)

(8) Place airfoil deicing switch in off position.

(9) Close left ground control relay circuit breaker.



Tail Duct Venturi Differential --
Pressure Switch Installation
Figure 201

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AIR INTAKES - DESCRIPTION AND OPERATION

1. Description

A. The air intakes consist of the engine nose cowl anti-icing valves (see Chapter 75), and the fuselage nose air-conditioning scoop anti-icing valves. The fuselage nose anti-icing valves control the flow of high-temperature engine bleed air from the low-pressure pneumatic manifold to the air-conditioning air intake scoops. The valves are installed in the anti-icing ducts located in the lower fuselage nose area.

2. Operation

A. The pneumatically actuated poppet-type valves are electrically controlled by an anti-icing switch located on the overhead switch panel. When the valve solenoids are electrically energized, air pressure from the low-pressure pneumatic manifold opens the valves. This allows anti-icing air to flow to the air-conditioning air intake scoops.

AIR INTAKES - DESCRIPTION AND OPERATION

1. Description

A. The anti-icing system for the air intakes consists of the following components:

Two fuselage nose air conditioning scoop anti-icing valves
One scoops anti-icing switch
Two outer wing pneumatic duct shutoff valves
Two inner wing vent scoop anti-icing valves (airplanes 801 through 804 only)

B. The fuselage nose air conditioning scoop anti-icing valves are mounted in the fuselage nose, one on each side of the centerline. Air to the left valve is supplied through the left rain removal duct and controls the airflow to the left air conditioning scoop. Air to the right valve is supplied through the right rain removal duct and controls the airflow to the right air conditioning scoop. The air from both valves exhausts overboard from the bottom of the fuselage nose, just forward of the nose-wheel well. These valves are electrically controlled and pneumatically actuated. With the pneumatic manifold pressurized, the valves remain open as long as the scoops anti-icing switch is in the ANTI-ICE position, even if power is removed from the circuit.

C. When placed in the ANTI-ICE position, the scoops anti-icing switch, located on the overhead switch panel, opens all valves including the outer wing pneumatic duct shutoff valves. The outer wing pneumatic duct shutoff valves are also controlled by the airfoil deicing switch.

D. On airplanes 801 through 804 an anti-icing valve for each inner wing vent scoop is located at the root of each wing leading edge. These valves also operate in the circuit with the fuselage nose air conditioning scoop anti-icing valves. Air for these inner wing vent scoop anti-icing valves is supplied directly from the pneumatic manifold that runs through the leading edge of each inner wing.

E. On airplanes 801 through 811 anti-icing air is supplied to outer wing vent scoops through the outer wing pneumatic ducts when the outer wing pneumatic duct shutoff valves are open. The air exhausts overboard through the wing leading edge exhaust slots located between the pylons of each wing.

AIR INTAKES - MAINTENANCE PRACTICES

1. General

   A. The scoops anti-icing switch controls the fuselage nose air-conditioning scoops anti-icing valves (left and right), and both outer wing pneumatic duct shutoff valves, which allow air to pass to the outer wing scoops.

   B. The engine anti-icing switches, one for both outboard and one for both inboard engines, control the nose cowl anti-icing valves in the corresponding engine nose cowls.

   C. The outer wing pneumatic duct shutoff valve is located at the junction of the pneumatic manifold and the outer wing penumatic duct. The fuselage nose scoops are located on the lower right and left side of the fuselage nose.

   D. The test boss for the test gage is located on the bottom of the rain removal duct, next to the low-pressure pneumatic manifold crossfeed shutoff valve. Access to the test boss is through access door 601.

   E. The thrust reverser flexible line is located in the engine pod on the engine pneumatic starter duct. Access to the line is through engine access door 70.

   F. The following tests check airflow from the anti-icing valves and compares the amount of airflow in pounds-per-minute with the established allowable amount, but the tests do not include the operation of the cowl and engine anti-icing indicating lights.

2. Tools and Equipment Required

Item	Name	Number	Manufacturer	Use
A	Air pressure gage with range of 0 to 60 psi and an accuracy within 0.6 psi			Measure pressure in airplane pneumatic manifold.
B	Pneumatic ground source (see Chapter 36)			Pressurize pneumatic manifold.
C	Fitting	AN 815-5		Connect pressure gage to pneumatic system test boss

3. Adjustment/Test Air Scoops

A. Test Airflow Rate through Anti-Icing Valves

(1) Place following controls in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Using AN 815-5 fitting and O-ring, connect pressure gage to test boss located on bottom of right rain removal duct next to low-pressure pneumatic manifold crossfeed shutoff valve.

NOTE: Manifold pressure should be maintained at 38 (±1/2) psig under all conditions of airflow. It is more convenient to monitor the manifold pressure by this gage than by the manifold pressure gage in the flight compartment.

(3) Disconnect and cap aft end of thrust reverser flexible line that extends from engine pneumatic starter duct on bleed air heat exchanger. Aft end of flexible line terminates in a fitting located above engine nose cowl island.

NOTE: This action prevents a potential loss of air from the pneumatic manifold due to engine thrust reverser system leakage. Pneumatic power requirements are correspondingly reduced, and a more accurate test of the valves is achieved.

(4) Connect pneumatic ground source and pressurize pneumatic manifold (see Chapter 36).

(5) Place pneumatic manifold crossfeed shutoff switch in closed position.

NOTE: The left section of the airplane pneumatic manifold is unpressurized when the crossfeed valve is closed.

(6) Record right pneumatic manifold leakage in pounds-per-minute of airflow as indicated by airflow test orifice of pneumatic power source.

(7) Check airflow of anti-icing valves connected to right pneumatic manifold according to procedures of Figure 201. Proceed from line 1 through line 4 as follows:

(a) Open indicated circuit breakers, located on heat, vent and ice protection section of EPC circuit breaker panel.

(b) Place scoops anti-icing switch in anti-ice position.

(c) Check that air flows through valve or valves under test. Airflow through double-wall construction of outer wing vent scoops can be detected by sound in affected areas. Air from fuselage nose scoops discharges overboard from beneath fuselage nose just forward of nosewheel well. Air from each engine nose cowl discharges from bottom of cowl.

NOTE: Steps (d) through (f) determine net airflow of line 1.

(d) Record amount of air flowing into right pneumatic manifold.

(e) Subtract right penumatic manifold leakage.

(f) Difference represents airflow through right outer wing vent scoop and leakage from outer wing pneumatic duct. Difference should be within range specified.

NOTE: Steps (g) through (i) determine net airflow of lir s 2 and 3.

(g) Record amount of air flowing into right penumatic manifold.

(h) Subtract right manifold leakage.

(i) Difference represents airflow through applicable (No. 3 or No. 4) engine cowl and should be within range specified.

NOTE: Steps (j) through (l) determine net airflow of line 4.

(j) Record amount of air flowing into right penumatic manifold.

(k) Subtract right manifold leakage.

(l) Difference represents airflow through fuselage right nose scoop and should be within range specified.

NOTE: In test on line 4, manifold undertemperature indicating light should come on when anti-icing switch is placed in anti-ice position, and should go off when switch is placed in off position.

LINE	FLOW TEST	OPEN CIRCUIT BREAKER				ALLOWABLE FLOW LBS/MIN	
		(OUTER) WING PNEUMATIC DUCT VALVES	LEFT AIR CONDITION SCOOP ANTI-ICE	RIGHT AIR CONDITION SCOOP ANTI-ICE	LANDING GEAR WARN & INTERLOCK	MIN	MAX
1	RIGHT OUTER WING VENT SCOOP (WITH LEAKAGE OF OUTER WING PNEUMATIC DUCT)			X		1.5	2.2
2	NO. 4 ENGINE COWL					102.0	116.0
3	NO. 3 ENGINE COWL					102.0	116.0
4	FUSELAGE RIGHT NOSE SCOOP	X			X	20.0	25.0

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Flow Rate Right Manifold Anti-Icing Valves
Figure 201

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(8) Place scoops anti-icing switch in off position.

(9) Close circuit breakers opened in Figure 201.

(10) Place pneumatic manifold crossfeed shutoff switch in down and guarded position.

NOTE: Both left and right sections of airplane pneumatic manifold are pressurized when crossfeed valve is open.

(11) Record combined leakage of both sections of pneumatic manifold in pounds-per-minute of airflow.

(12) Check airflow of anti-icing valves according to procedures of Figure 202. Proceed from line 1 through 4 as follows:

(a) Open indicated circuit breakers, located on heat, vent and ice protection section of EPC circuit breaker panel.

(b) Place scoops anti-icing switch in anti-ice position.

(c) Check that air flows through valve or valves under test. Airflow through double-wall construction of outer wing vent scoops can be detected by sound in affected areas. Air flow from fuselage nose scoops discharges overboard from beneath fuselage nose just forward of nosewheel well. Air from each engine nose cowl discharges from bottom of cowl.

NOTE: Steps (d) through (g) determine net airflow of line 1.

(d) Record amount of air flowing into both halves of pneumatic manifold.

(e) Subtract manifold leakage.

(f) Subtract amount determined in step (7) (f).

(g) Difference represents airflow through left outer wing vent scoop and leakage from left outer wing pneumatic duct, and should be within range specified.

NOTE: Steps (h) through (i) determine net airflow of lines 2 and 3.

(h) Record amount of air flowing into both halves of pneumatic manifold.

(i) Subtract manifold leakage.

(j) Difference represents airflow through applicable (No. 1 or No. 2) engine cowl, and should be within range specified.

LINE	FLOW TEST	OPEN CIRCUIT BREAKER						ALLOWABLE FLOW LBS/MIN	
		(OUTER) WING PNEUMATIC DUCT VALVES	LANDING GEAR WARN & INTERLOCK	LEFT AIR CONDITION SCOOP ANTI-ICE	ENGINE ANTI-ICE 3	ENGINE ANTI-ICE 4	RIGHT AIR CONDITION SCOOP ANTI-ICE	MIN	MAX
1	LEFT OUTER WING VENT SCOOP (WITH LEAKAGE OF OUTER WING PNEUMATIC DUCTS)			X			X	1.5	2.5
2	NO. 1 ENGINE COWL					X		98.0	112.0
3	NO. 2 ENGINE COWL				X			98.0	112.0
4	FUSELAGE LEFT NOSE SCOOP	X	X				X	20.0	25.0

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Flow Rate Left and Right Manifold
Anti-Icing Valves
Figure 202

NOTE: Steps (k) through (m) determine net airflow of line 5.

(k) Record amount of air flowing into both halves of pneumatic manifold.

(l) Subtract manifold leakage.

(m) Difference represents airflow through fuselage left nose scoop and should be within range specified.

(13) Place scoops anti-icing switch in off position.

(14) Close circuit breakers opened in Figure 201.

(15) Depressurize pneumatic manifold and disconnect pneumatic ground source.

(16) Connect thrust reverser flexible line to thrust reverser system (four places).

(17) Remove test gage from right rain removal duct and install plug in test boss.

B. Anti-Icing Valves Operation

(1) Place following controls in position indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect pneumatic ground source and pressurize pneumatic manifold. (See Chapter 36.)

(3) Check that landing gear control lever is in down position.

(4) Place scoops anti-icing switch in anti-ice position, and listen or feel for anti-icing airflow through outer wing pneumatic duct shutoff valves.

NOTE: Airflow through double-wall areas of outer wing vent scoops is evidence that outer wing pneumatic duct shutoff valves are open.

(5) Open left air-condition scoop anti-ice circuit breaker, located on heat, vent and ice protection (dc) bus section of EPC circuit breaker panel.

(6) Open landing gear warning and interlock circuit breaker, located on miscellaneous (dc) section of EPC circuit breaker panel.

(7) Check by sound, or feel for anti-icing airflow through right fuselage nose air-conditioning scoop anti-icing valve.

(8) Check latching feature of both outer wing pneumatic duct shutoff valves, and right fuselage nose scoop anti-icing valve, by opening outer wing pneumatic duct valves and right air-condition scoop anti-ice circuit breakers located on heat, vent and ice protection (dc) bus section of EPC circuit breaker panel.

(9) Determine by sound or feel that anti-icing air continues to flow through outer wing vent scoops, and right fuselage nose air-conditioning scoop.

(10) Close outer wing pneumatic duct valves and right air-condition scoop anti-ice circuit breakers.

(11) Place scoops anti-icing switch in off position. Check that anti-icing airflow from all valves listed in step (4) and step (7) (as applicable) has stopped.

(12) Open outer wing pneumatic duct valves and right air-condition scoop anti-ice circuit breakers located on heat, vent and ice protection (dc) bus section of EPC circuit breaker panel.

(13) Close left air-condition scoop anti-ice circuit breaker.

(14) Place scoops anti-icing switch in anti-ice position. Listen or feel for airflow from left fuselage nose air-conditioning scoop anti-icing valve.

(15) Check latching feature of above valve by opening left air-condition scoop anti-ice circuit breakers and determining that air continues to flow.

(16) Close landing gear warning and interlock, and left air-condition scoop anti-ice circuit breakers.

(17) Check by sound or feel for no anti-icing airflow, indicating that left fuselage nose air-conditioning scoop anti-icing valve has closed.

(18) Place scoops anti-icing switch in off position.

(19) Close outer wing pneumatic duct valves and right air-conditioning scoop anti-ice circuit breakers.

(20) Shutoff ground pneumatic supply and relieve pressure in pneumatic manifold by moving either rain removal lever to the on position.

(21) Depressurize pneumatic manifold and disconnect ground pneumatic source (see Chapter 36).

AIR INTAKES - MAINTENANCE PRACTICES

1. General

A. The scoops anti-icing switch controls the fuselage nose air-conditioning scoops anti-icing valves (left and right), and both outer wing pneumatic duct shutoff valves, which allow air to pass to the outer wing scoops.

B. The engine anti-icing switches, one for both outboard and one for both inboard engines, control the nose cowl anti-icing valves in the corresponding engine nose cowls.

C. The outer wing pneumatic duct shutoff valve is located at the junction of the pneumatic manifold and the outer wing pneumatic duct. The fuselage nose scoops are located on the lower right and left side of the fuselage nose.

D. The test boss for the test gage is located on the bottom of the rain removal duct, next to the low-pressure pneumatic manifold crossfeed shutoff valve. Access to the test boss is through access door 601.

E. The thrust reverser flexible line is located in the engine pod on the engine pneumatic starter duct. Access to the line is through engine access door 70.

F. The following tests check airflow from the anti-icing valves and compares the amount of airflow in pounds-per-minute with the established allowable amount, but the tests do not include the operation of the cowl and engine anti-icing indicating lights.

2. Tools and Equipment Required

Item	Name	Number	Manufacturer	Use
A	Air Pressure gage with range of 0 to 60 psi and an accuracy within 0.6 psi			Measure pressure in airplane pneumatic manifold.
B	Pneumatic ground source (see Chapter 36)			Pressurize pneumatic manifold.
C	Fitting	AN 815-5		Connect pressure gage to pneumatic system test boss

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3. Adjustment/Test Air Scoops

A. Test Airflow Rate through Anti-Icing Valves

(1) Place following controls in positions indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Using AN 815-5 fitting and O-ring, connect pressure gage to test boss located on bottom of right rain removal duct next to low-pressure pneumatic manifold crossfeed shutoff valve.

NOTE: Manifold pressure should be maintained at 38 (±1/2) psig under all conditions of airflow. It is more convenient to monitor the manifold pressure by this gage than by the manifold pressure gage in the flight compartment.

(3) On airplanes 812 and subsequent, disconnect and cap aft end of thrust reverser flexible line that extends from engine pneumatic starter duct on bleed air heat exchanger. Aft end of flexible line terminates in a fitting located above engine nose cowl island.

NOTE: This action prevents a potential loss of air from the pneumatic manifold due to engine thrust reverser system leakage. Pneumatic power requirements are correspondingly reduced, and a more accurate test of the valves is achieved.

(4) Connect pneumatic ground source and pressurize pneumatic manifold (see Chapter 36).

(5) Place pneumatic manifold crossfeed shutoff switch in closed position.

NOTE: The left section of the airplane pneumatic manifold is unpressurized when the crossfeed valve is closed.

(6) Record right pneumatic manifold leakage in pounds-per-minute of airflow as indicated by airflow test orifice of pneumatic power source.

(7) Check airflow of anti-icing valves connected to right pneumatic manifold according to procedures of Figure 201. Proceed from line 1 through line 5 as follows:

(a) Open indicated circuit breakers, located on heat, vent and ice protection section of EPC circuit breaker panel.

(b) Place applicable scoops anti-icing switch in anti-ice position.

NOTE: Engine anti-icing switches control nose cowl anti-icing valves in corresponding engine nose cowls. Single scoops anti-icing switch controls fuselage nose air conditioning scoops anti-icing valves, outer wing pneumatic duct shutoff valves, and on airplanes 801-804 the inner wing vent scoop anti-icing valves.

(c) Check that air flows through valve or valves under test. Airflow through double-wall construction of outer wing vent scoops can be detected by sound in affected areas. Air from fuselage nose scoops discharges overboard from beneath fuselage nose just forward of nosewheel well. Air from each engine nose cowl discharges from bottom of cowl.

NOTE: Steps (d) through (f) determine net airflow of line 1 for airplanes 801 - 804 only.

(d) Record amount of air flowing into right pneumatic manifold.

(e) Subtract right pneumatic manifold leakage.

(f) Difference represents airflow through right inner wing vent scoop. Difference should be within range specified.

NOTE: Steps (g) through (i) determine net airflow of line 2.

(g) Record amount of air flowing into right pneumatic manifold.

(h) Subtract right pneumatic manifold leakage.

NOTE: On airplanes 801 - 804, also subtract airflow recorded through right inner wing vent scoop.

(i) Difference represents airflow through right outer wing vent scoop and leakage from outer wing pneumatic duct and should be within range specified.

NOTE: Steps (j) through (l) determine net airflow of lines 3 and 4.

(j) Record amount of air flowing into right pneumatic manifold.

LINE	FLOW TEST	OPEN CIRCUIT BREAKER					ALLOWABLE FLOW LBS/MIN	
		(OUTER) WING PNEUMATIC DUCT VALVES	LEFT AIR CONDITION SCOOP ANTI-ICE	RIGHT AIR CONDITION SCOOP ANTI-ICE	LANDING GEAR WARN & INTERLOCK	WING VENTILATION SCOOPS ANTI-ICE (801-804 ONLY)	MIN	MAX
1	RIGHT INNER WING VENT SCOOP 801-804 ONLY	X		X			1.5	2.0
2	RIGHT OUTER WING VENT SCOOP (WITH LEAKAGE OF OUTER WING PNEUMATIC DUCT)			X			1.5	2.2
3	NO. 4 ENGINE COWL							
	801-811						79.0	87.0
	812-866						102.0	116.0
	867						73.0	86.0
4	NO. 3 ENGINE COWL							
	801-811						79.0	87.0
	812-866						102.0	116.0
	867						73.0	86.0
5	FUSELAGE RIGHT NOSE SCOOP							
	801-866	X			X	X		
	867	X	X		X		20.0	25.0

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Flow Rate Right Manifold Anti-Icing Valves
Figure 201

(k) Subtract right manifold leakage.

(l) Difference represents airflow through applicable (No. 3 or No. 4) engine cowl and should be within range specified.

NOTE: Steps (m) through (o) determine net airflow of line 5.

(m) Record amount of air flowing into right pneumatic manifold.

(n) Subtract right manifold leakage.

(o) Difference represents airflow through fuselage right nose scoop and should be within range specified.

NOTE: In test on line 5, manifold undertemperature indicating light should come on when anti-icing switch is placed in anti-ice position, and should go off when switch is placed in off position.

(8) Place scoops anti-icing switch in off position.

(9) Close circuit breakers opened in Figure 201.

(10) Place pneumatic manifold crossfeed shutoff switch in down and guarded position.

NOTE: Both left and right sections of airplane pneumatic manifold are pressurized when crossfeed valve is open.

(11) Record combined leakage of both sections of pneumatic manifold in pounds-per-minute of airflow.

(12) Check airflow of anti-icing valves according to procedures of Figure 202. Proceed from line 1 through 5 as follows:

(a) Open indicated circuit breakers, located on heat, vent and ice protection section of EPC circuit breaker panel.

(b) Place scoops anti-icing switch in anti-ice position.

(c) Check that air flows through valve or valves under test. Airflow through double-wall construction of outer wing vent scoops can be detected by sound in affected areas. Air flow from fuselage nose scoops discharges overboard from beneath fuselage nose just forward of nosewheel well. Air from each engine nose cowl discharge from bottom of cowl.

NOTE: Steps (d) through (g) determine net airflow of line 1 for airplanes 801 - 804 only.

(d) Record amount of air flowing into both halves of pneumatic manifold.

(e) Subtract manifold leakage.

(f) Subtract amount determined in step (7) (f).

(g) Difference represents airflow through left inner wing vent scoop and leakage from left outer wing pneumatic duct, and should be within range specified.

NOTE: Steps (h) through (i) determine net airflow of line 2.

(h) Record amount of air flowing into both halves of pneumatic manifold.

(i) Subtract manifold leakage.

(j) Subtract amount determined in step (7) (i).

(k) Difference represents airflow through left outer wing scoop and leakage from left outer wing pneumatic duct, and should be within range specified.

NOTE: Steps (l) through (n) determine net airflow of lines 3 and 4.

(l) Record amount of air flowing into both halves of pneumatic manifold.

(m) Subtract manifold leakage.

(n) Difference represents airflow through applicable (No. 1 or No. 2) engine cowl, and should be within range specified.

NOTE: Steps (o) through (q) determine net airflow of line 5.

(o) Record amount of air flowing into both halves of pneumatic manifold.

(p) Subtract manifold leakage.

(q) Difference represents airflow through fuselage left nose scoop and should be within range specified.

(13) Place scoops anti-icing switch in off position.

(14) Close circuit breakers opened in Figure 201.

(15) Depressurize pneumatic manifold and disconnect pneumatic ground source.

(16) Connect thrust reverser flexible line to thrust reverser system (four places).

(17) Remove test gage from right rain removal duct and install plug in test boss.

LINE	FLOW TEST	OPEN CIRCUIT BREAKER							ALLOWABLE FLOW LBS/MIN	
		WING VENTILATION SCOOPS ANTI-ICE (801-804 ONLY)	(OUTER) WING PNEUMATIC DUCT VALVES	LANDING GEAR WARN & INTERLOCK	LEFT AIR CONDITION SCOOP ANTI-ICE	ENGINE ANTI-ICE 3	ENGINE ANTI-ICE 4	RIGHT AIR CONDITION SCOOP ANTI-ICE	MIN	MAX
1	LEFT INNER WING VENT SCOOP 801-804 ONLY		X		X			X	1.5	2.2
2	LEFT OUTER WING VENT SCOOP (WITH LEAKAGE OF OUTER WING PNEUMATIC DUCT)				X			X	1.5	2.5
3	NO. 1 ENGINE COWL									
	801-811						X		79.0	87.0
	812-866								102.0	116.0
	867								73.0	86.0
4	NO. 2 ENGINE COWL									
	801-811					X			79.0	87.0
	812-866								102.0	116.0
	867								73.0	86.0
5	FUSELAGE LEFT NOSE SCOOP									
	801-866	X	X	X				X	20.0	25.0
	867		X	X				X		

HA2-4995A

Flow Rate Left and Right Manifold
Anti-Icing Valves
Figure 202

B. Anti-Icing Valves Operation

(1) Place following controls in position indicated.

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect pneumatic ground source and pressurize pneumatic manifold. (See Chapter 36.)

(3) Check that landing gear control lever is in down position.

(4) Place scoops anti-icing switch in anti-ice position, and listen or feel for anti-icing airflow through outer wing pneumatic duct shutoff valves. On airplanes 801-804, check airflow through inner wing vent scoop valves.

NOTE: Airflow through double-wall areas of outer wing vent scoops is evidence that outer wing pneumatic duct shutoff valves are open.

(5) Open left air-condition scoop anti-ice circuit breaker, located on heat, vent and ice protection (dc) bus section of EPC circuit breaker panel.

(6) Open landing gear warning and interlock circuit breaker, located on miscellaneous (dc) section of EPC circuit breaker panel.

(7) Check by sound, or feel for anti-icing airflow through right fuselage nose air-conditioning scoop anti-icing valve.

(8) Check latching feature of both outer wing pneumatic duct shutoff valves, and right fuselage nose scoop anti-icing valve, by opening outer wing pneumatic duct valves and right air-condition scoop anti-ice circuit breakers located on heat, vent and ice protection (dc) bus section of EPC circuit breaker panel.

(9) Determine by sound or feel that anti-icing air continues to flow through outer wing vent scoops, and right fuselage nose air-conditioning scoop.

(10) Close outer wing pneumatic duct valves and right air-condition scoop anti-ice circuit breakers.

(11) Place scoops anti-icing switch in off position. Check that anti-icing airflow from all valves listed in step (4) and step (7) (as applicable) has stopped.

(12) Open outer wing pneumatic duct valves and right air-condition scoop anti-ice circuit breakers located on heat, vent and ice protection (dc) bus section of EPC circuit breaker panel.

(13) Close left air-condition scoop anti-ice circuit breaker.

(14) Place scoops anti-icing switch in anti-ice position. Listen or feel for airflow from left fuselage nose air-conditioning scoop anti-icing valve.

(15) Check latching feature of above valve by opening left air-condition scoop anti-ice circuit breakers and determining that air continues to flow.

(16) Close landing gear warning and interlock, and left air-condition scoop anti-ice circuit breakers.

(17) Check by sound or feel for no anti-icing airflow, indicating that left fuselage nose air-conditioning scoop anti-icing valve has closed.

(18) Place scoops anti-icing switch in off position.

(19) Close outer wing pneumatic duct valves and right air-conditioning scoop anti-ice circuit breakers.

(20) Shutoff ground pneumatic supply and relieve pressure in pneumatic manifold by moving either rain removal lever to the on position.

(21) Depressurize pneumatic manifold and disconnect ground pneumatic source (See Chapter 36).

ENGINE NOSE COWL ANTI-ICING - MAINTENANCE PRACTICES

REFER TO CHAPTER 75

FUSELAGE NOSE AIR CONDITIONING SCOOP ANTI-ICING VALVES - MAINTENANCE PRACTICES

1. General

   A. The fuselage nose air-conditioning scoop anti-icing valves are installed in the anti-icing ducts located in the lower fuselage nose area. Access to the valves is through access door 601.

   B. The Removal/Installation procedures for the left and right fuselage nose air-conditioning scoop anti-icing valves are identical except as noted.

2. Tools and Equipment Required

   A. A pneumatic ground source is required to supply manifold pressure during Adjustment/Test of valves.

3. Removal/Installation Fuselage Nose Air-Conditioning Scoop Anti-Icing Valves

   A. Remove Anti-Icing Valves

      (1) Open applicable air-conditioning scoop anti-icing circuit breaker, located on the heat, vent and ice protection (dc bus) section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Disconnect and cap electrical connector from fuselage nose air-conditioning scoop anti-icing valve.

      NOTE: The left valve is clamped to a bracket attached to fuselage structure.

      (3) Loosen clamps that connect valve to anti-icing duct, and remove valve.

      CAUTION: PROTECT OPEN PORTS AND LINES WITH PLASTIC CAPS.

   B. Install Anti-Icing Valves

      (1) Make certain that air-conditioning scoop anti-icing circuit breaker is open.

      (2) Place fuselage nose air-conditioning scoop anti-icing valve in position, and tighten clamps at anti-icing duct.

      (3) Tighten clamp at elbow assembly to torque of 45 (±5) inch-pounds.

      (4) Connect electrical connector to valve.

      (5) Close air-conditioning scoop anti-icing circuit breaker.

4. Adjustment/Test Fuselage Nose Air-Conditioning Scoop Anti-Icing Valves

A. Test Anti-Icing Valves

(1) Place following controls in positions indicated:

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Open landing gear and warning interlock circuit breaker located on (dc bus) EPC circuit breaker panel.

(3) Connect pneumatic ground source and pressurize pneumatic manifold (see Chapter 36).

(4) Place scoops anti-icing switch in anti-icing position.

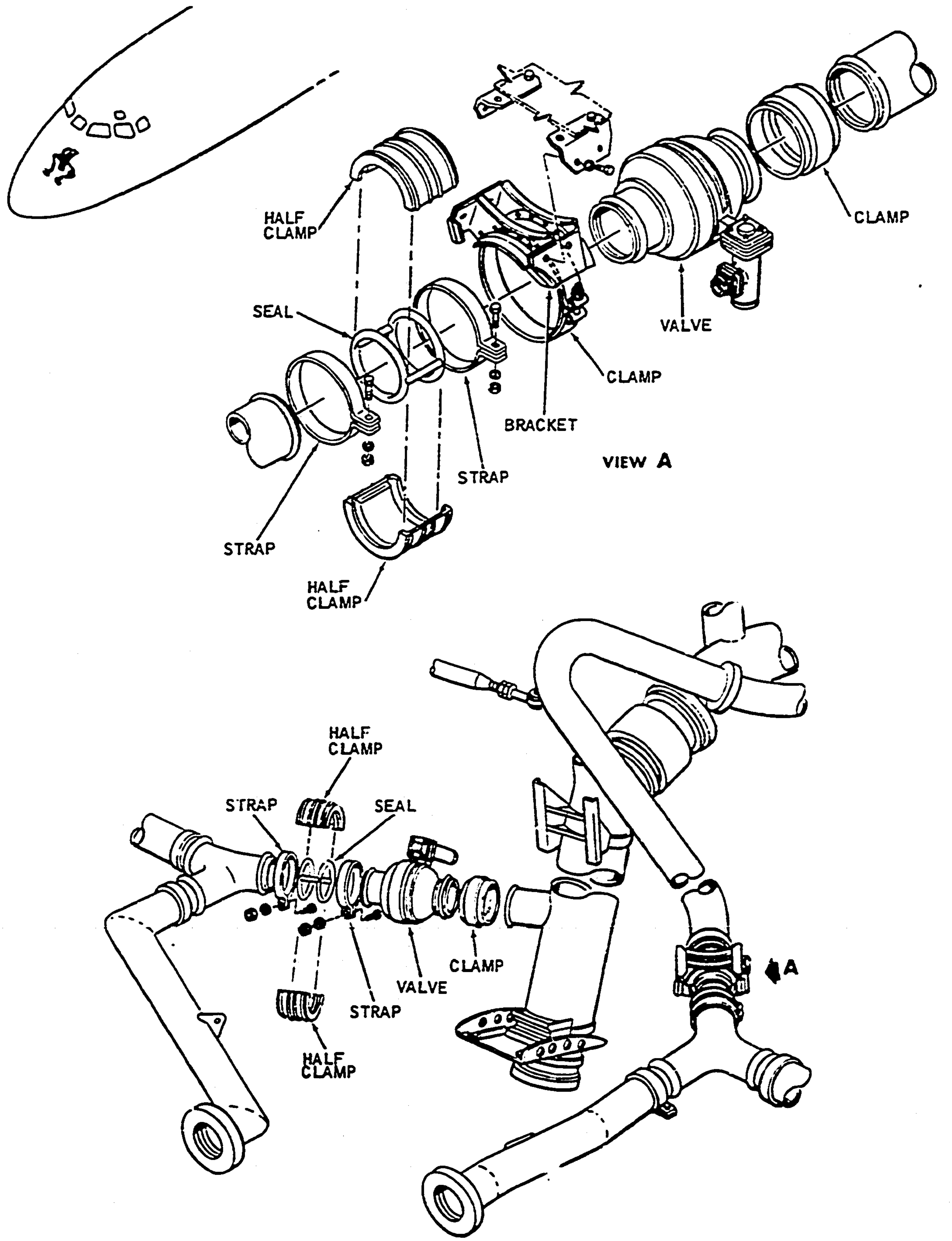
(5) Check by sound and feel for airflow from vents for fuselage nose air-conditioning scoops.

(6) Place scoops anti-icing switch in off position.

(7) Determine that air-conditioning scoop anti-icing valves have closed, as indicated by an absence of airflow from scoops.

(8) Depressurize pneumatic manifold and disconnect pneumatic ground source (see Chapter 36).

(9) Close landing gear and warning interlock circuit breakers.



Fuselage Nose Air-Conditioning Scoop Anti-Icing
Valves -- Installation
Figure 201

WING VENT SCOOP ANTI-ICING VALVES - MAINTENANCE PRACTICES

1. General

A. The wing vent scoop anti-icing valves are located on the inboard leading edge of the wing. Access to the valves is through wing access door 549.

B. The removal/installation procedures for the left and right wing vent scoop anti-icing valves are identical.

2. Removal/Installation Wing Vent Scoop Anti-Icing Valves

A. Remove Wing Vent Scoop Anti-Icing Valve

(1) Open wing ventilation scoops anti-ice circuit breaker, located on heat, vent, and ice protection dc bus section of circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER.

(2) Disconnect and cap electrical connector from wing vent scoop anti-icing valve.

(3) Disconnect inlet end of valve from wing ventilation inlet duct elbow.

(4) Remove clamp attached to outlet end of valve.

(5) Remove valve from support bracket.

B. Install Wing Vent Scoop Anti-Icing Valve

(1) Make certain that wing ventilation scoops anti-ice circuit breaker is open.

(2) Position valve in support bracket and install clamp on outlet end of valve and connecting duct.

(3) Connect inlet end of valve to wing ventilation inlet duct elbow.

(4) Connect electrical connector to valve.

(5) Close wing ventilation scoops anti-ice circuit breaker.

3. Adjustment/Test Wing Vent Scoop Anti-Icing Valve

A. Test Wing Vent Scoop Anti-icing Valve

(1) Place following flight compartment controls in indicated positions:

Control	Position
Fire control handles	Normal
Windshield rain removal levers	Off
Engines anti-icing switches	Off
Scoops anti-icing switch	Off
Airfoil deicing switch	Off
Pneumatic manifold crossfeed shutoff switch	Down and guarded
Tail duct valve switch	Normal
Cabin compressor switches	Off
Freon compressor switches	Off
Pneumatic shutoff switches	Off
Starter/ignition switches	Off

(2) Connect pneumatic ground source and pressurize pneumatic manifold. (See Chapter 36.)

(3) Place scoops anti-icing switch in anti-ice position.

(4) Check for sound of air at applicable wing vent scoop, indicating that wing scoop anti-icing valve is open.

(5) Place scoops anti-icing switch in off position.

(6) Determine that wing vent scoop anti-icing valve has closed, as indicated by absence of airflow at applicable wing vent scoop.

(7) Depressurize pneumatic manifold and disconnect the ground pneumatic source. (See Chapter 36.)

PITOT AND STATIC - DESCRIPTION AND OPERATION

1. General

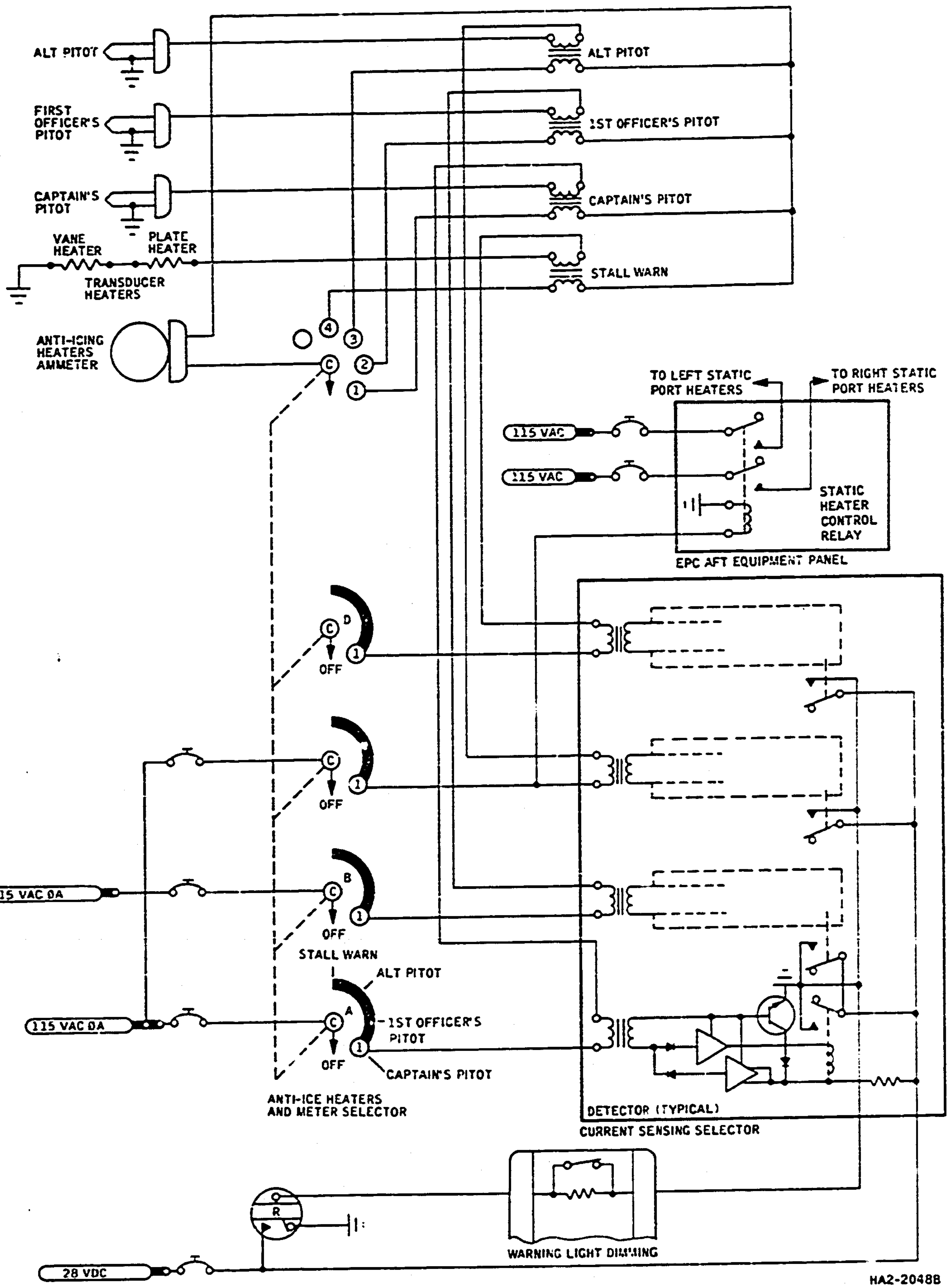
A. Ice protection is provided by electrical heating elements for the captain's, first officer's, and alternate pitot tubes, the stall warning lift transducer, and the static ports. The anti-icing heating system is comprised of the pitot tube and static port heating elements, the heater for the stall warning lift transducer, the anti-icing heater and ammeter selector switch, the current sensing detector, the heater transformer, and the heater failure indicating light.

2. Description

A. The heating elements consist of fine resistance wire sealed in the assembly, with provisions for external connection to ac power. The anti-icing heater and ammeter selector switch, located on the overhead switch panel, is a rotary-type switch. The switch connects power to the heater elements through the current sensing detector and heater transformer, and also arms the failure indicating light circuit. When the switch is in any of the on positions, all the heaters are energized. The ammeter, located adjacent to the switch, indicates the electrical load of the heater corresponding to the switch position through the heater transformer. The current sensing detector, located in the EPC aft center equipment panel, consists of a transformer that supplies power to operate a relay coil, and contacts that interlock the failure indicating light circuit. The heater failure light is located on the overhead switch panel and is a push-to-test, dimmable, amber light. When the pitot heater switch is on, the light goes on if there is a malfunction in any of the pitot heaters.

CAUTION: TO PROLONG SERVICE LIFE OF PITOT TUBE AND LIFT TRANSDUCER HEATING ELEMENTS, MAKE CERTAIN THAT ANTI-ICING HEATERS SWITCH IS TURNED OFF WHEN AIRPLANE IS ON GROUND.

B. The heating element for the static ports consist of an aluminum sleeve onto which is wound a heating element, with provisions for external connection to ac power. The heater switch connects power to the static port heater control relay and 115 vac is supplied to the heater element through the relay contacts.



Pitot and Static System -- Electrical Schematic
Figure 1

PITOT AND STATIC - DESCRIPTION AND OPERATION

1. General

A. Ice protection is provided by electrical heating elements for the captain's, first officer's, alternate, and flight recorder pitot tubes, the speed command left, speed command right, and outside air temperature sensors, the stall warning lift transducer, and the static ports. The anti-icing heating system is comprised of the pitot tube and static port heating elements, the heater for the stall warning lift transducer, the speed command left, speed command right, outside air temperature sensors, the anti-icing heater and ammeter selector switch, the current sensing detector, the heater transformer, and the heater failure indicating light.

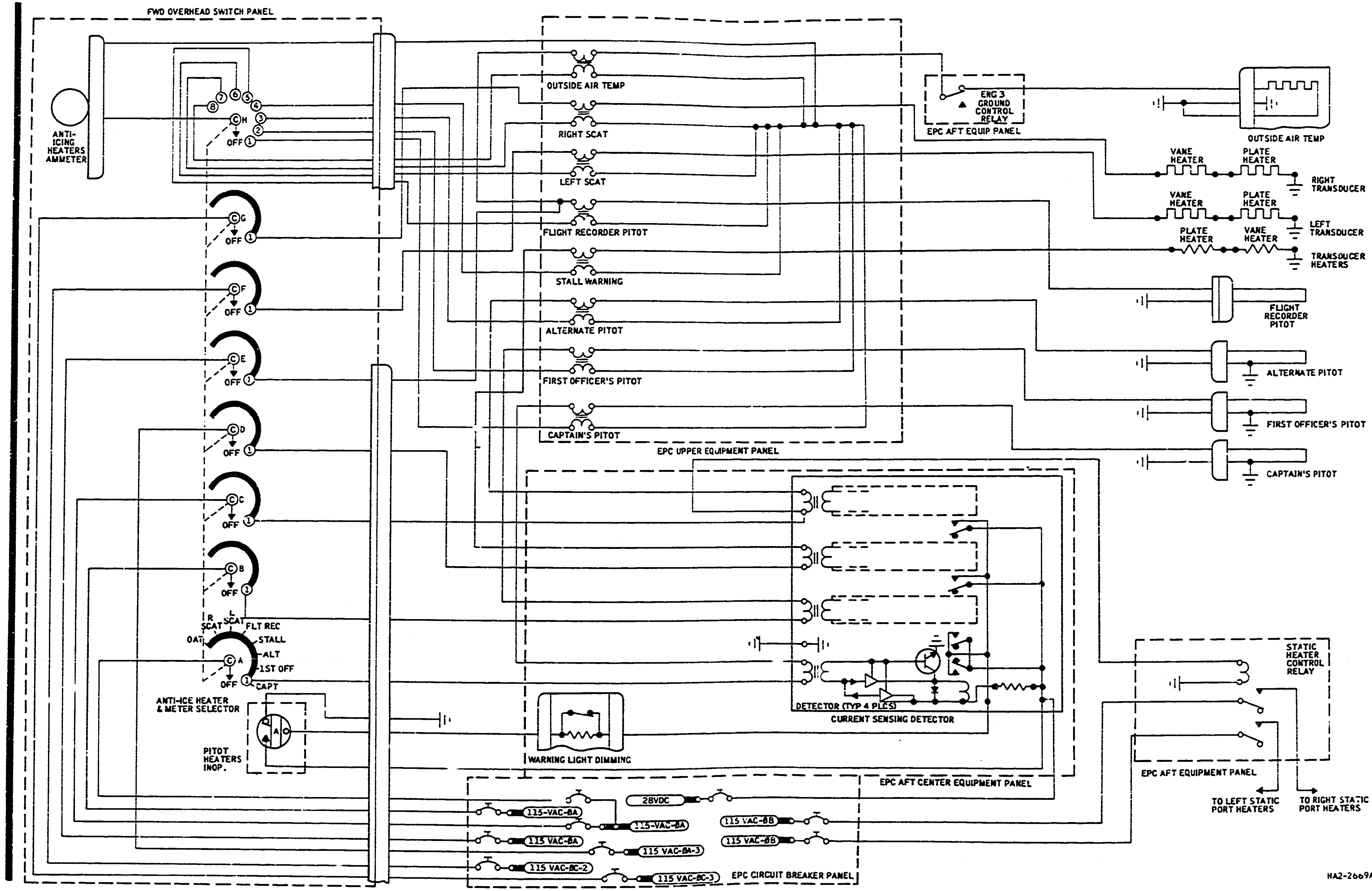
2. Description

A. The heating elements consist of fine resistance wire sealed in the assembly, with provisions for external connection to ac power. The anti-icing heater and ammeter selector switch, located on the overhead switch panel, is a rotary-type switch. The switch connects power to the heater elements through the current sensing detector and heater transformer and also arms the failure indicating light circuit. When the switch is in any of the on positions, all the heaters are energized. The ammeter, located adjacent to the switch, indicates the electrical load of the pitot heater corresponding to the switch position through the heater transformer. The current sensing detector, located on the EPC aft center equipment panel, consists of a transformer that supplies power to operate a relay coil, and contacts that interlock the failure indicating light circuit. The heater failure light is located on the overhead switch panel and is a push-to-test, dimmable, amber light. When the pitot heater switch is on, the light goes on if there is a malfunction in any of the pitot heaters except the flight recorder.

CAUTION: TO PROLONG SERVICE LIFE OF PITOT TUBE AND LIFT TRANSDUCER HEATING ELEMENTS, MAKE CERTAIN THAT ANTI-ICING HEATERS SWITCH IS TURNED OFF WHEN AIRPLANE IS ON GROUND.

B. The heating element for the static ports consist of an aluminum sleeve onto which is wound a heating element, with provisions for external connection to ac power. The heater switch connects power to the static port heater control relay and 115 vac is supplied to the heater element through the relay contacts.

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Pitot and Static System --
Electrical Schematic
Figure 1

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PITOT AND STATIC - DESCRIPTION AND OPERATION

1. General

A. Ice protection is provided by electrical heating elements for the captain's, first officer's, flight recorder, and alternate pitot tubes, the stall warning lift transducer, the static ports, and the outside air temperature sensors. The anti-icing heating system is comprised of the pitot tube and static port heating elements, the heater for the stall warning lift transducer and outside air temperature sensors, the anti-icing heater and ammeter selector switch, the current sensing detector, the heater transformer, and the heater failure indicating light.

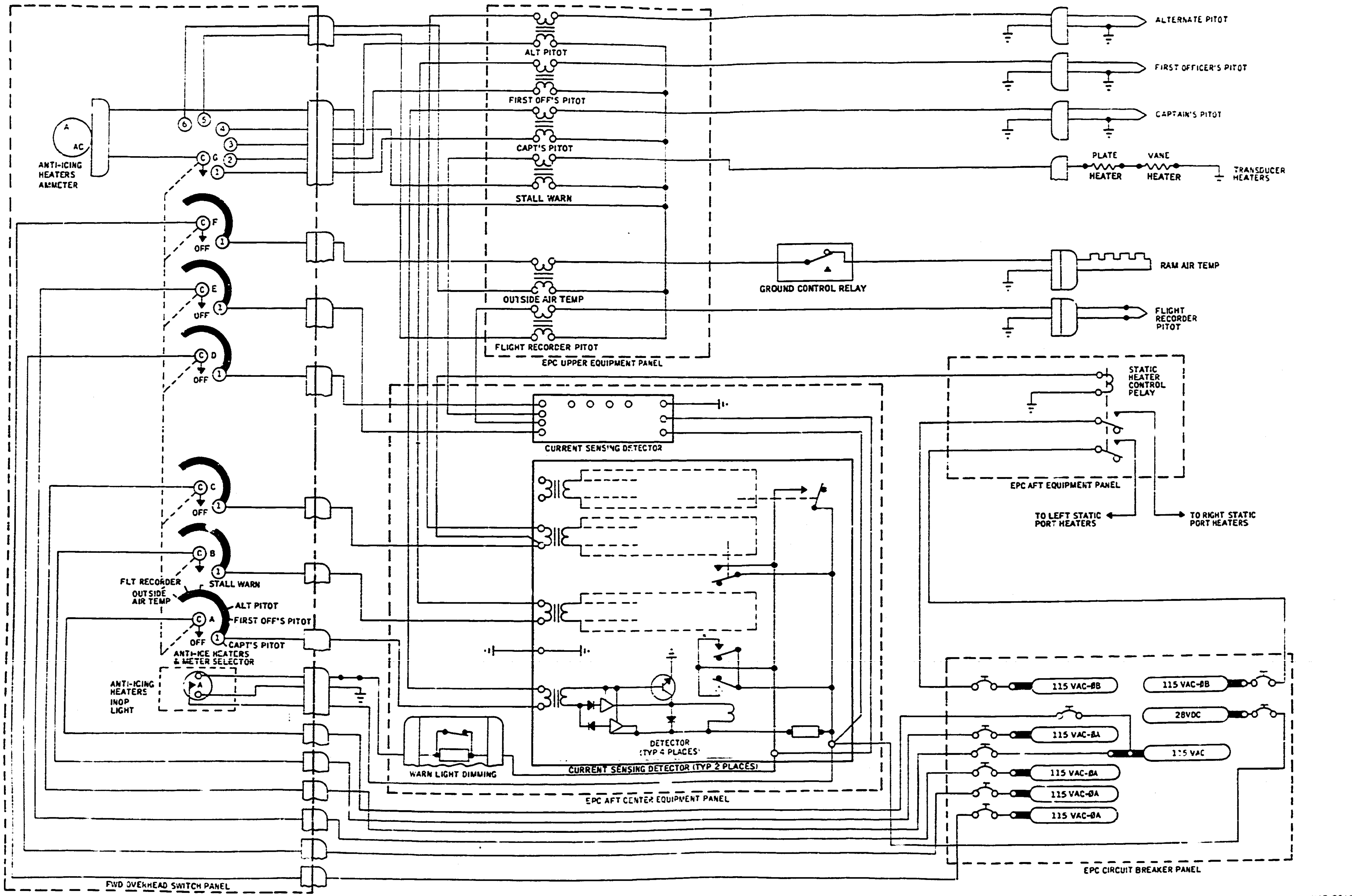
2. Description

A. The heating elements consist of fine resistance wire sealed in the assembly, with provisions for external connection to ac power. The anti-icing heater and ammeter selector switch, located on the overhead switch panel, is a rotary-type switch. The switch connects power to the heater elements through the current sensing detector and heater transformer and also arms the failure indicating light circuit. When the switch is in any of the on positions, all the heaters are energized. The ammeter, located adjacent to the switch, indicates the electrical load of the heater corresponding to the switch position through the heater transformer. The current sensing detector, located on the EPC aft center equipment panel, consists of a transformer that supplies power to operate a relay coil, and contacts that interlock the failure indicating light circuit. The heater failure light is located on the overhead switch panel and is a push-to-test, dimmable, amber light. When the pitot heater switch is on, the light goes on if there is a malfunction in any of the pitot heaters.

CAUTION: TO PROLONG SERVICE LIFE OF PITOT TUBE AND LIFT TRANSDUCER HEATING ELEMENTS, MAKE CERTAIN THAT ANTI-ICING HEATERS SWITCH IS TURNED OFF WHEN AIRPLANE IS ON GROUND.

B. The heating element for the static ports consist of an aluminum sleeve onto which is wound a heating element, with provisions for external connection to ac power. The heater switch connects power to the static port heater control relay and 115 vac is supplied to the heater element through the relay contacts.

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Pitot and Static System -- Electrical Schematic
Figure 1

PITOT AND STATIC - DESCRIPTION AND OPERATION

1. General

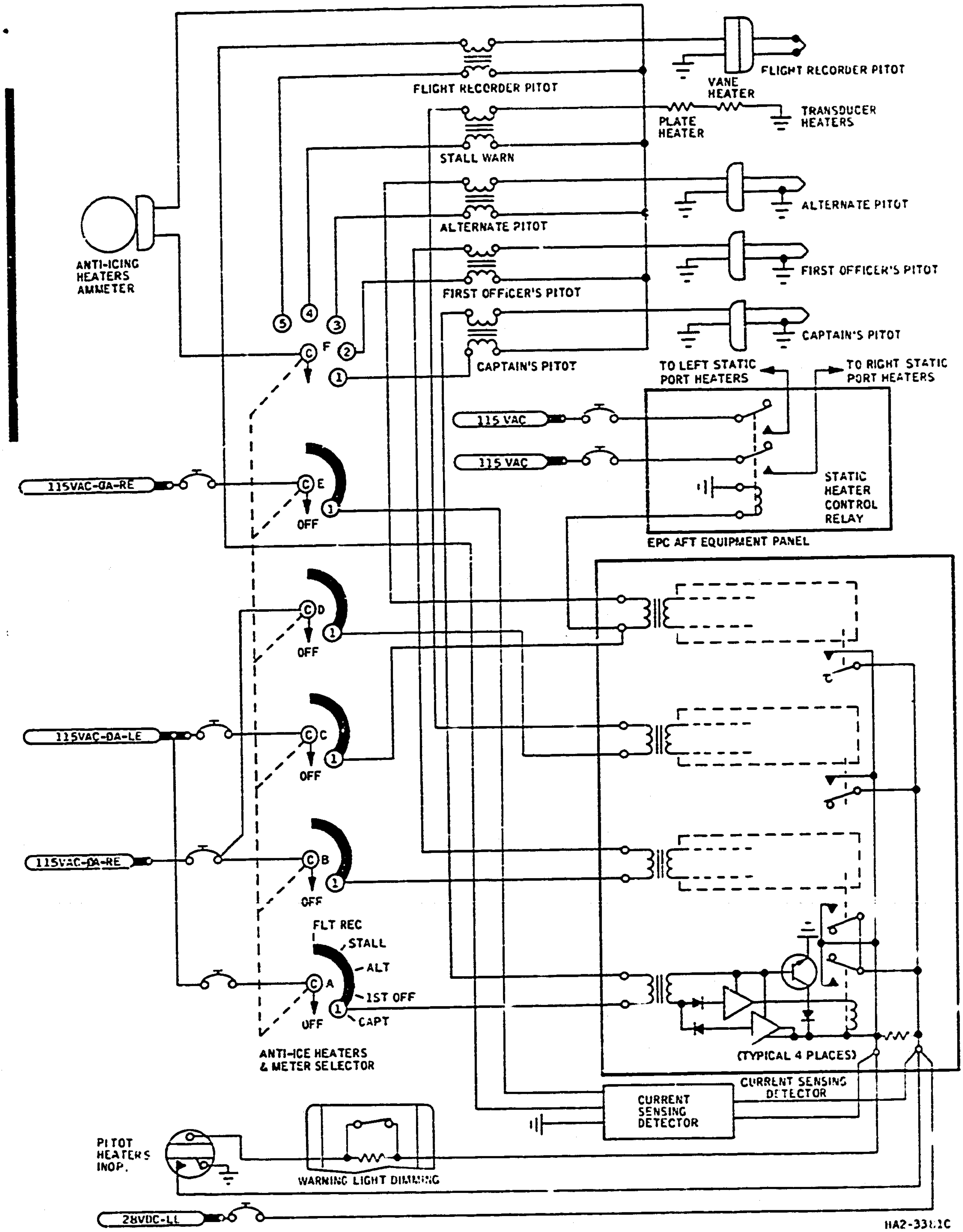
A. Ice protection is provided by electrical heating elements for the captain's, first officer's, flight recorder and alternate pitot tubes, the stall warning lift transducer, and the static ports. The anti-icing heating system is comprised of the pitot tube and static port heating elements, the heater for the stall warning lift transducer, the anti-icing heater and ammeter selector switch, the current sensing detector, the heater transformer, and the heater failure indicating light.

2. Description

A. The heating elements consist of fine resistance wire sealed in the assembly, with provisions for external connection to ac power. The anti-icing heater and ammeter selector switch, located on the overhead switch panel, is a rotary-type switch. The switch connects power to the heater elements through the current sensing detector and heater transformer and also arms the failure indicating light circuit. When the switch is in any of the on positions, all the heaters are energized. The ammeter, located adjacent to the switch, indicates the electrical load of the heater corresponding to the switch position through the heater transformer. The current sensing detector, located in the EPC aft center equipment panel, consists of a transformer that supplies power to operate a relay coil, and contacts that interlock the failure indicating light circuit. The heater failure light is located on the overhead switch panel and is a push-to-test, dimmable, amber light. When the pitot heater switch is on, the light goes on if there is a malfunction in any of the pitot heaters.

CAUTION: TO PROLONG SERVICE LIFE OF PITOT TUBE AND LIFT TRANSDUCER HEATING ELEMENTS, MAKE CERTAIN THAT ANTI-ICING HEATERS SWITCH IS TURNED OFF WHEN AIRPLANE IS ON GROUND.

B. The heating element for the static ports consist of an aluminum sleeve onto which is wound a heating element, with provisions for external connection to ac power. The heater switch connects power to the static port heater control relay and 115 vac is supplied to the heater element through the relay contacts.



Pitot and Static System --
Electrical Schematic
Figure 1

PITOT AND STATIC - DESCRIPTION AND OPERATION

1. General

A. Ice protection for the Captain's, First Officer's, and alternate pitot tubes the static ports, and for the stall warning lift transducer is provided by electrical heating elements. The anti-icing heating system consists of the pitot tube and static port heating elements, the heater for the stall warning lift transducer, the anti-icing heaters switch, the pitot heater warning relays, the static port heater control relay, and the heater failure indicating lights.

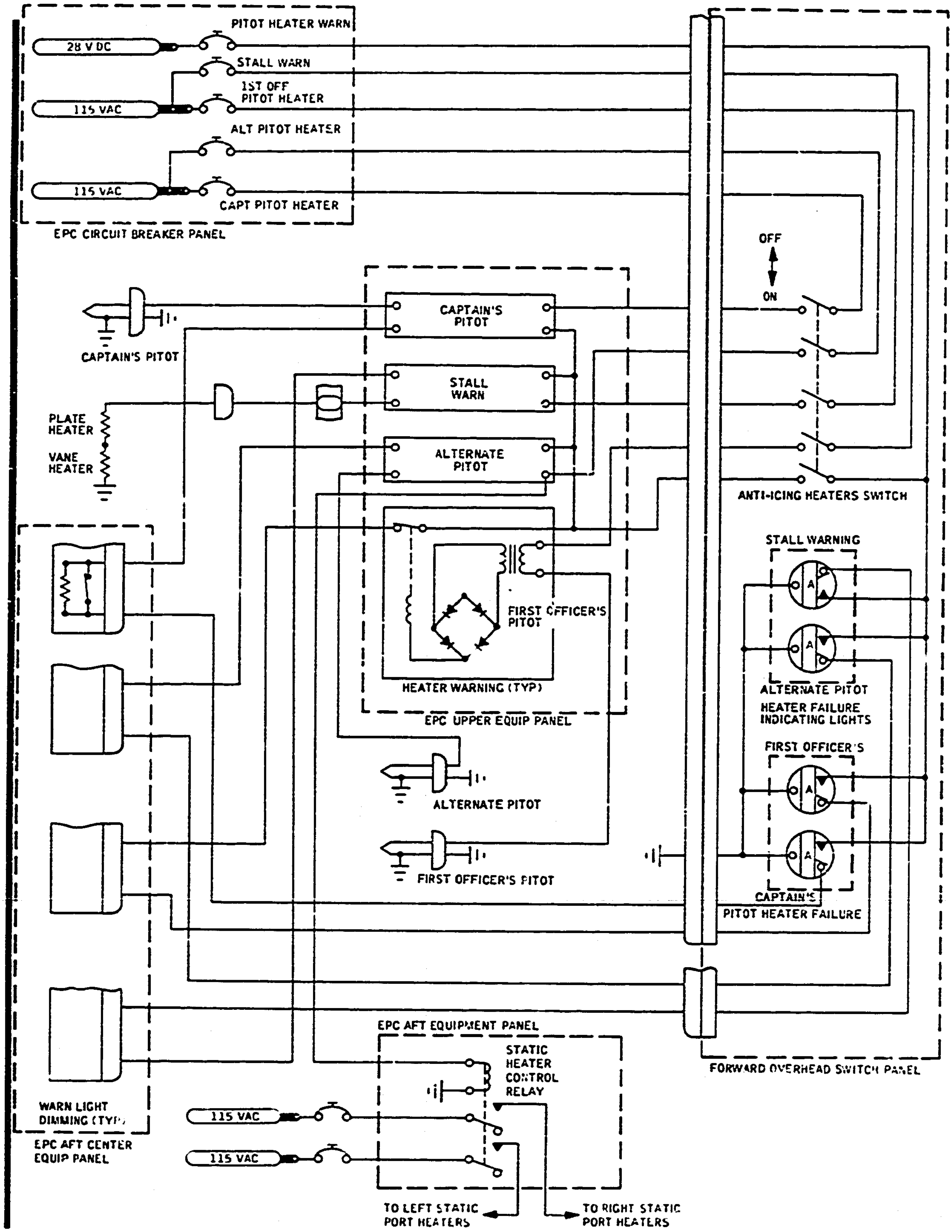
2. Description

A. The pitot tube heating elements consist of fine resistance wire sealed in the assembly, with provisions for external connection to ac power. The heaters switch is located on the overhead switch panel. The switch connects power to the heater elements through the heater warning relays and arms the failure warning light circuit. The heater warning relays, located on the upper equipment panel, consist of a transformer powered bridge rectifier that supplies power to operate a relay coil, and contacts that interlock the failure indicating light circuit. The heater failure lights are located on the overhead switch panel and are push-to-test, dimmable, amber lights. The lights go on when the pitot heater switch is on, if there is insufficient power to the heating elements in the pitot tubes.

CAUTION: TO PROLONG THE SERVICE LIFE OF THE PITOT TUBE AND LIFT TRANSDUCER HEATING ELEMENTS, MAKE CERTAIN THAT THE ANTI-ICING HEATERS SWITCH IS TURNED OFF WHEN THE AIRPLANE IS ON THE GROUND.

B. The heating element for the static ports consist of an aluminum sleeve onto which is wound a heating element, with provisions for external connection to ac power. The heater switch connects power to the static port heater control relay and 115 vac is supplied to the heater element through the relay contacts.

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Pitot and Static System -- Electrical Schematic
Figure 1

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PITOT AND STATIC - DESCRIPTION AND OPERATION

1. General

A. Ice protection for the pitot tubes and for the stall warning lift transducer is provided by electrical heating elements. On airplanes 860 and subsequent ice protection for the static ports is provided by electrical heating elements. The anti-icing heating system consists of the pitot tube and static port heating elements, the heater for the stall warning lift transducer, the anti-icing heaters switch, the pitot heater warning relays, the static port heater control relay, and the heater failure indicating lights.

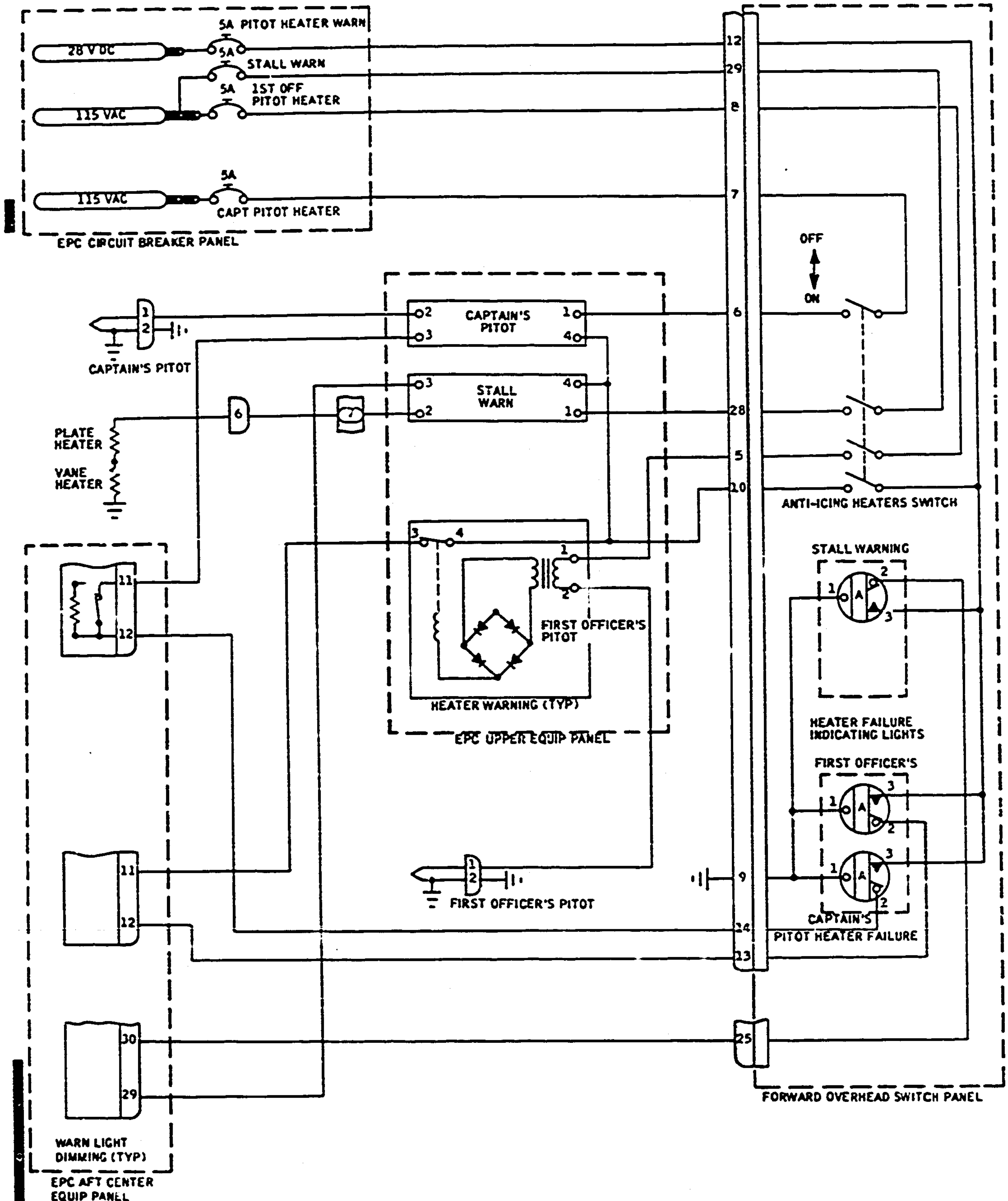
B. On airplanes 801 through 816, ice protection is provided for the captain's and first officer's pitot tubes. On airplanes 817 and subsequent, protection is provided for the captain's, first officer's, and alternate pitot tubes.

2. Description

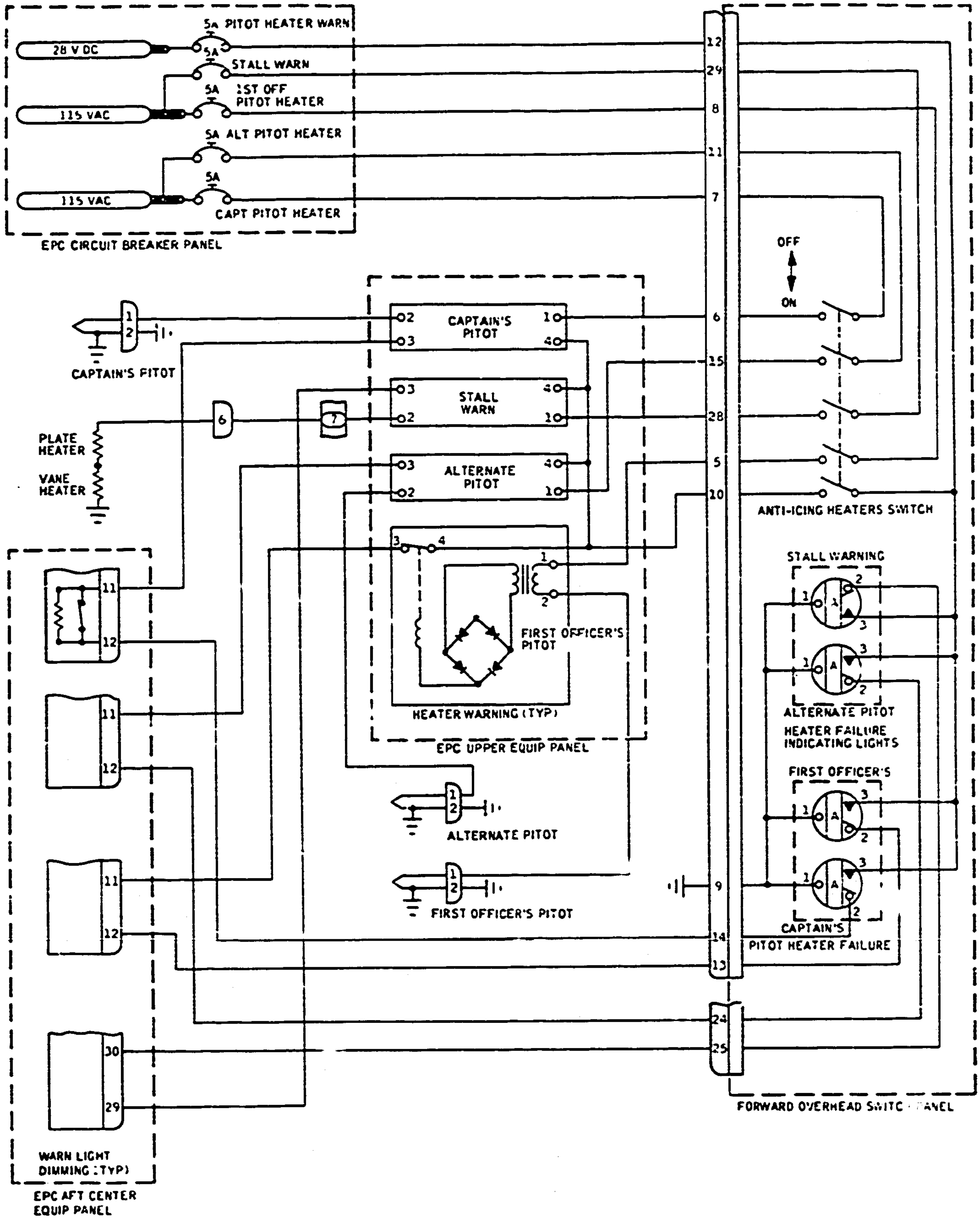
A. The pitot tube heating elements consist of fine resistance wire sealed in the assembly, with provisions for external connection to ac power. The heaters switch is located on the overhead switch panel. The switch connects power to the heater elements through the heater warning relays and arms the failure warning light circuit. The heater warning relays, located on the upper equipment panel, consist of a transformer powered bridge rectifier that supplies power to operate a relay coil, and contacts that interlock the failure indicating light circuit. The heater failure lights are located on the overhead switch panel and are push-to-test, dimmable, amber lights. The lights go on when the pitot heater switch is on, if there is insufficient power to the heating elements in the pitot tubes.

CAUTION: TO PROLONG THE SERVICE LIFE OF THE PITOT TUBE AND LIFT TRANSDUCER HEATING ELEMENTS, MAKE CERTAIN THAT THE ANTI-ICING HEATERS SWITCH IS TURNED OFF WHEN THE AIRPLANE IS ON THE GROUND.

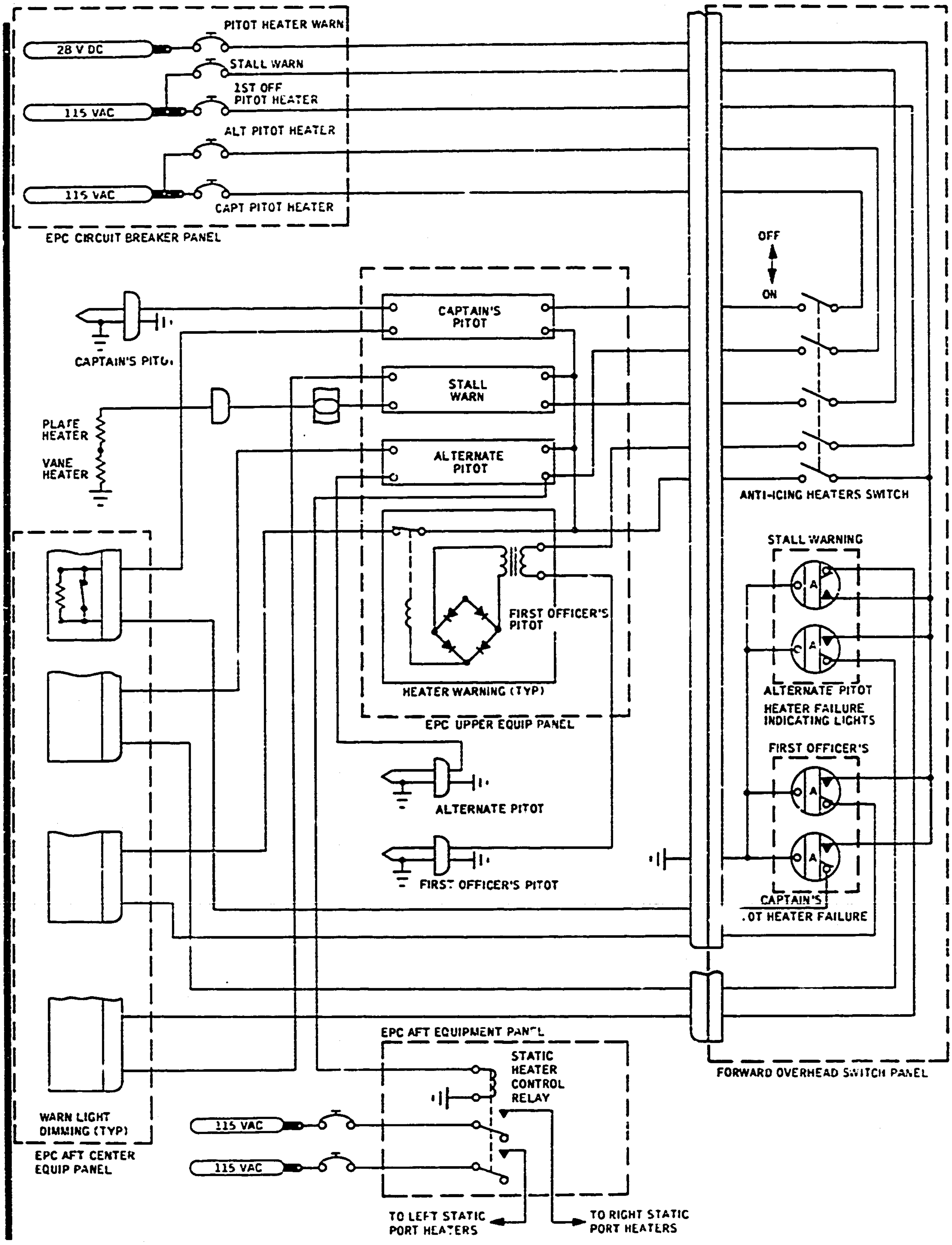
B. The heating element for the static ports consist of an aluminum sleeve onto which is wound a heating element, with provisions for external connection to ac power. The heater switch connects power to the static port heater control relay and 115 vac is supplied to the heater element through the relay contacts.



Pitot and Static System -- Electrical Schematic
(Airplanes 801 - 816)
Figure 1 (Sheet 1)



Pitot and Static System -- Electrical Schematic
(Airplanes 817 - 822)
Figure 1 (Sheet 2)



Pitot and Static System -- Electrical Schematic
(Airplanes 860 and subsequent)
Figure 1 (Sheet 3)

PITOT AND STATIC - DESCRIPTION AND OPERATION

1. General

A. Ice protection is provided by electrical heating elements for the captain's, first officer's, alternate and flight recorder pitot tubes, stall warning lift transducer, outside air data probe and the static ports. The anti-icing heating system is comprised of the pitot tube and static port heating elements, the heater for the stall warning lift transducer, and outside air temperature sensors, the anti-icing heater and ammeter selector switch, the current sensing detector, the heater transformer, and the heater failure indicating light.

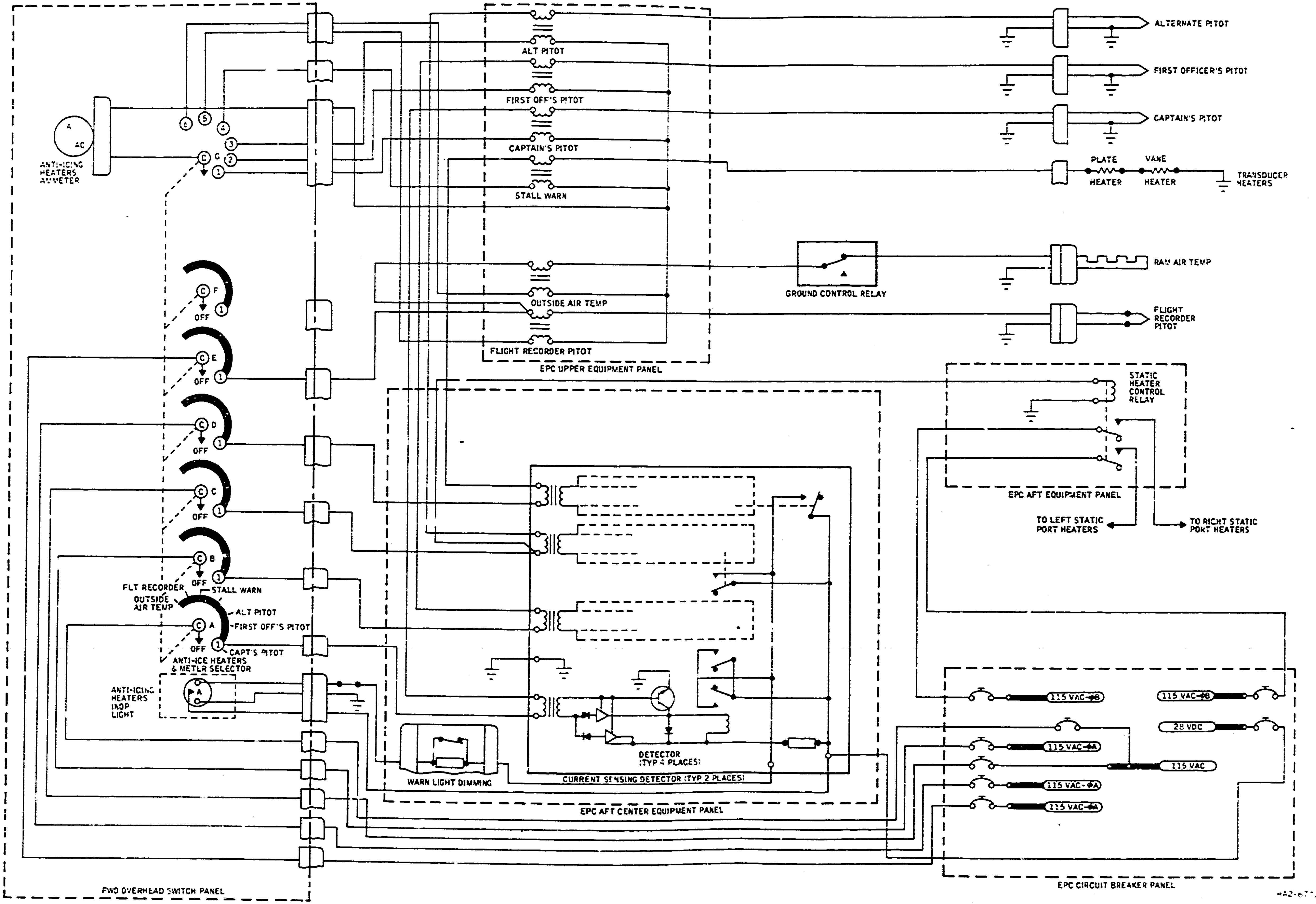
2. Description

A. The heating elements consist of fine resistance wire sealed in the assembly, with provisions for external connection to ac power. The anti-icing heater and ammeter selector switch, located on the overhead switch panel, is a rotary-type switch. The switch connects power to the heater elements through the current sensing detector and heater transformer and also arms the failure indicating light circuit. When the switch is in any of the on positions, all the heaters are energized. The ammeter, located adjacent to the switch, indicates the electrical load of the heater corresponding to switch position through the heater transformer. The current sensing detector located in the EPC aft center equipment panel, consists of a transformer that supplies power to operate a relay coil, and contacts that interlock the failure indicating light circuit. The heater failure light is located on the overhead switch panel and is a push-to-test, dimmable, amber light. When the pitot heater switch is on, the light goes on if there is a malfunction in any of the pitot heaters except the flight recorder.

CAUTION: TO PROLONG SERVICE LIFE OF PITOT TUBE AND LIFT TRANSDUCER HEATING ELEMENTS, MAKE CERTAIN THAT ANTI-ICING HEATERS SWITCH IS TURNED OFF WHEN AIRPLANE IS ON GROUND.

B. The heating element for the static ports consist of an aluminum sleeve onto which is wound a heating element, with provisions for external connection to ac power. The heater switch connects power to the static port heater control relay and 115 vac is supplied to the heater element through the relay contacts.

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Pitot and Static System -- Electrical Schematic
Figure 1

PITOT AND STATIC - DESCRIPTION AND OPERATION

1. General

A. Ice protection is provided by electrical heating elements for the captain's, first officer's, alternate and flight recorder pitot tubes, stall warning lift transducer, outside air temperature sensors and the static ports. The anti-icing heating system is comprised of the pitot tube and static port heating elements, the heater for the stall warning lift transducer, and outside air temperature sensors, the anti-icing heater and ammeter selector switch, the current sensing detector, the heater transformer and the heater failure indicating light.

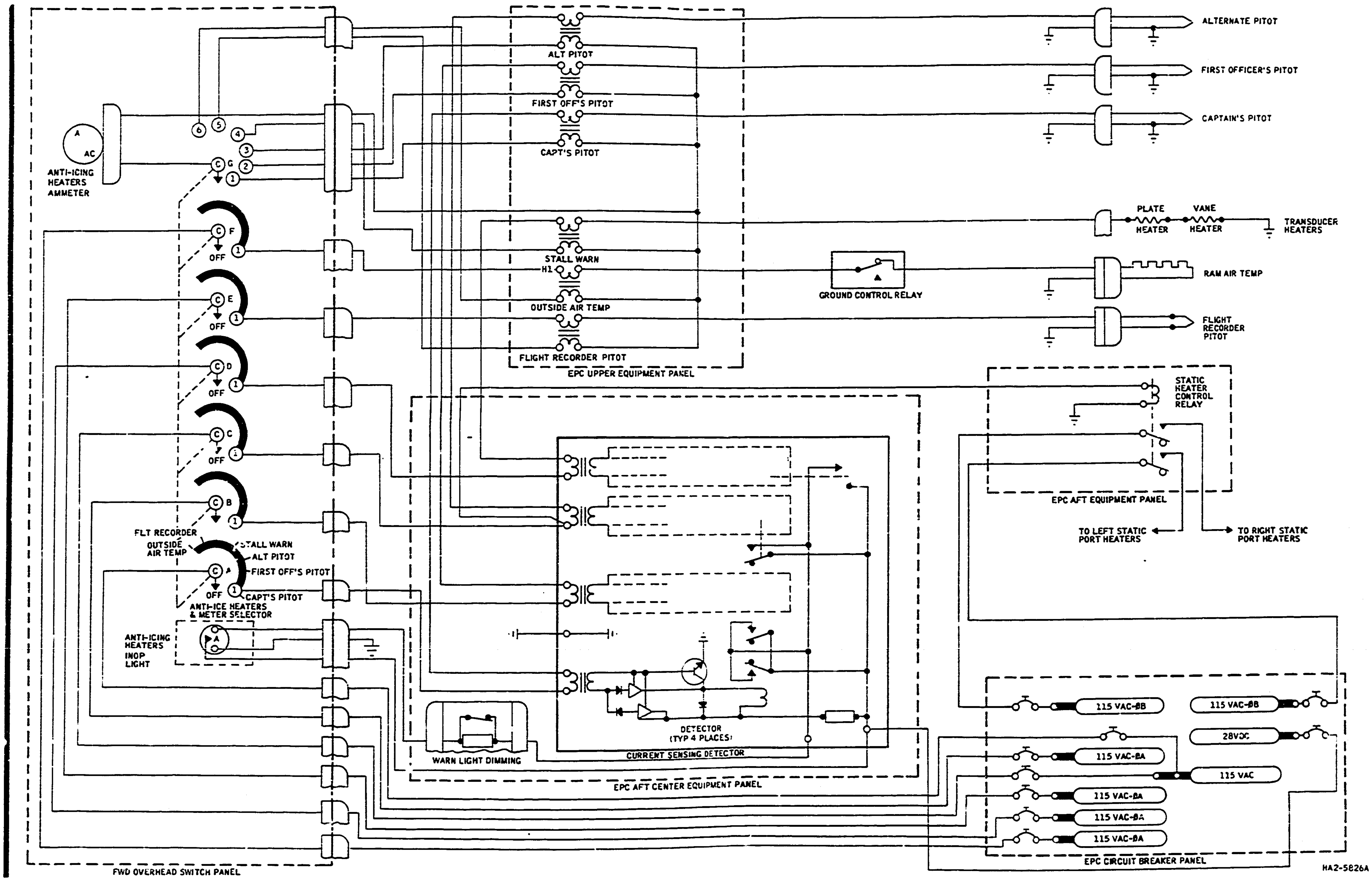
2. Description

A. The heating elements consist of fine resistance wire sealed in the assembly, with provisions for external connection to ac power. The anti-icing heater and ammeter selector switch, located on the overhead switch panel, is a rotary-type switch. The switch connects power to the heater elements through the current sensing detector and heater transformer and also arms the failure indicating light circuit. When the switch is in any of the on positions, all the heaters are energized. The ammeter, located adjacent to the switch, indicates the electrical load of the heater corresponding to switch position through the heater transformer. The current sensing detector, located in the EPC aft center equipment panel, consists of a transformer that supplies power to operate a relay coil, and contacts that interlock the failure indicating light circuit. The heater failure light is located on the overhead switch panel and is a push-to-test, dimmable, amber light. When the pitot heater switch is on, the light goes on if there is a malfunction in any of the pitot heaters except the flight recorder.

CAUTION: TO PROLONG SERVICE LIFE OF PITOT TUBE AND LIFT TRANSDUCER HEATING ELEMENTS, MAKE CERTAIN THAT ANTI-ICING HEATERS SWITCH IS TURNED OFF WHEN AIRPLANE IS ON GROUND.

B. The heating element for the static ports consist of an aluminum sleeve onto which is wound a heating element, with provisions for external connection to ac power. The heater switch connects power to the static port heater control relay and 115 vac is supplied to the heater element through the relay contacts.

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Pitot and Static System -- Electrical Schematic
Figure 1

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PITOT AND STATIC - DESCRIPTION AND OPERATION

1. General

A. Ice protection is provided by electrical heating elements for the captain's, first officer's, and alternate pitot tubes, the stall warning lift transducer, the static ports, and the outside air temperature probes. The anti-icing heating system is comprised of the pitot tube and static port heating elements, the heater for the stall warning lift transducer and outside air temperature sensors, the anti-icing heater and ammeter selector switch, the current sensing detector, the heater transformer, and the heater failure indicating light.

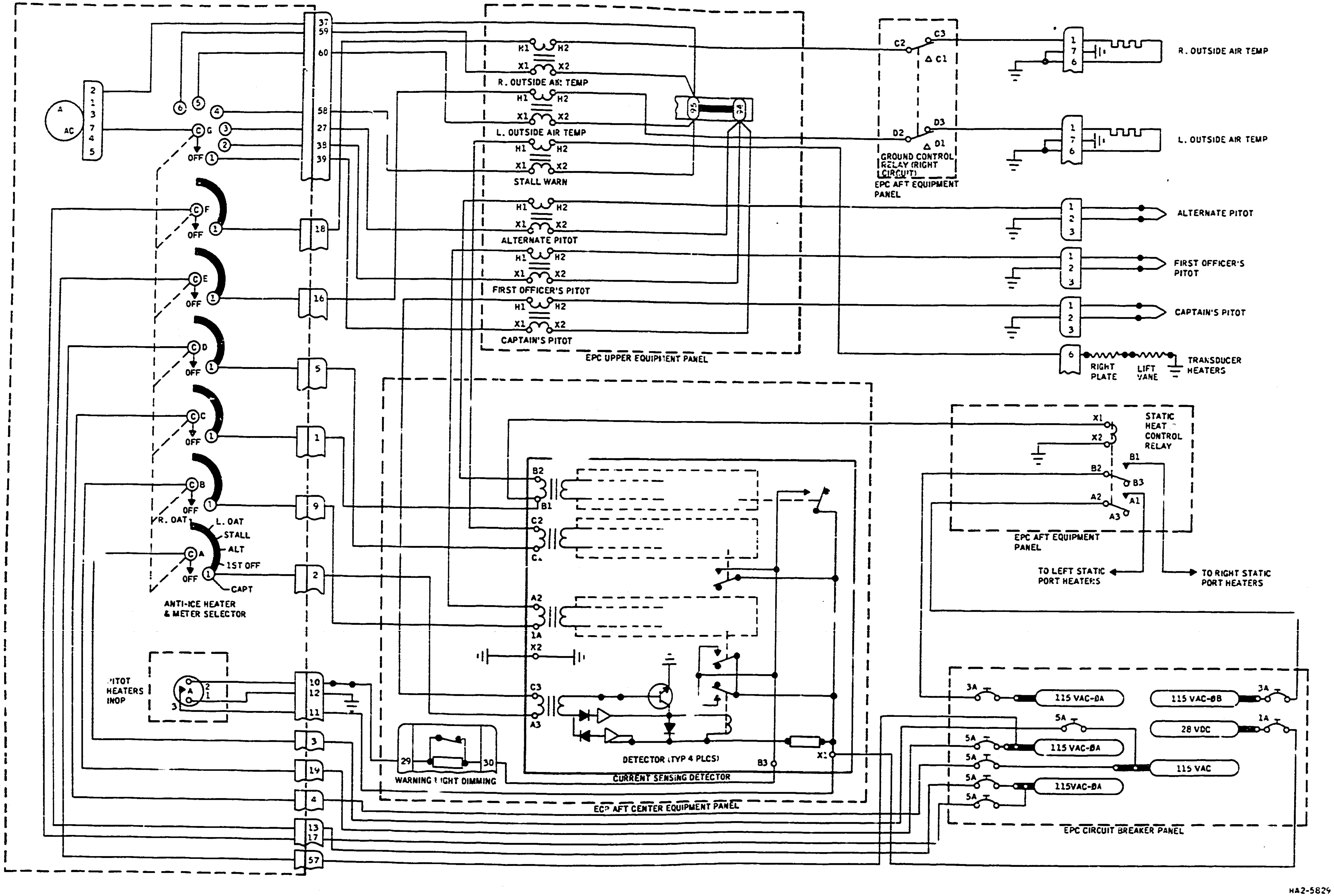
2. Description

A. The heating elements consist of fine resistance wire sealed in the assembly, with provisions for external connection to ac power. The anti-icing heater and ammeter selector switch, located on the overhead switch panel, is a rotary-type switch. The switch connects power to the heater elements through the current sensing detector and heater transformer, and also arms the failure indicating light circuit. When the switch is in any of the on positions, all the heaters are energized. The ammeter, located adjacent to the switch, indicates the electrical load of the heater corresponding to the switch position through the heater transformer. The current sensing detector, located on the EPC aft center equipment panel, consists of a transformer that supplies power to operate a relay coil, and contacts that interlock the failure indicating light circuit. The heater failure light is located on the overhead switch panel and is a push-to-test, dimmable, amber light. When the pitot heater switch is on, the light goes on if there is a malfunction in any of the pitot heaters.

CAUTION: TO PROLONG SERVICE LIFE OF PITOT TUBE AND LIFT TRANSDUCER HEATING ELEMENTS, MAKE CERTAIN THAT ANTI-ICING HEATERS SWITCH IS TURNED OFF WHEN AIRPLANE IS ON GROUND.

B. The heating element for the static ports consist of an aluminum sleeve onto which is wound a heating element, with provisions for external connection to ac power. The heater switch connects power to the static port heater control relay and 115 vac is supplied to the heater element through the relay contacts.

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Pitot and Static System -- Electrical Schematic
Figure 1

PITOT AND STATIC - DESCRIPTION AND OPERATION

1. General

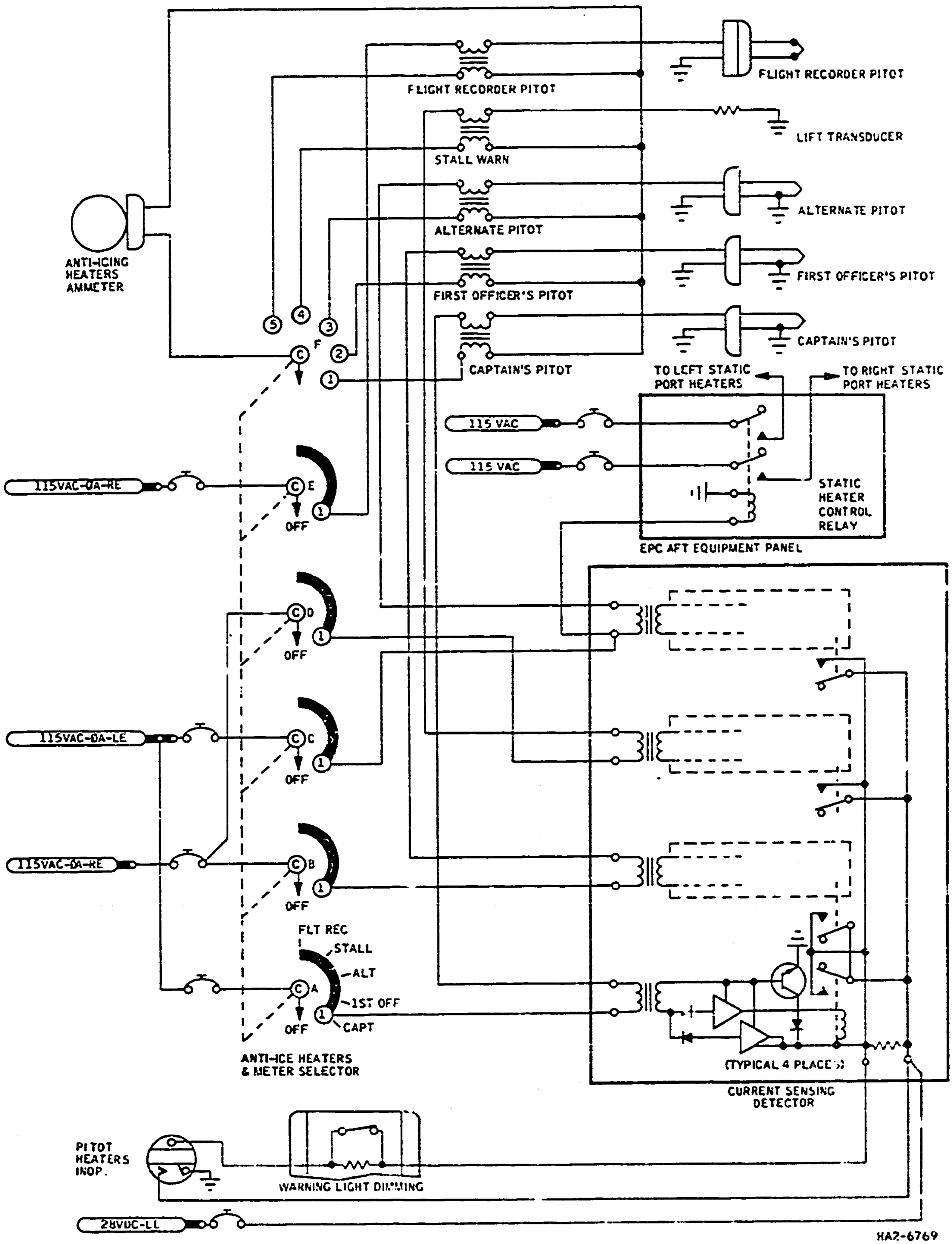
A. Ice protection is provided by electrical heating elements for the captain's, first officer's, flight recorder and alternate pitot tubes, the stall warning lift transducer, and the static ports. The anti-icing heating system is comprised of the pitot tube and static port heating elements, the heater for the stall warning lift transducer, the anti-icing heater and ammeter selector switch, the current sensing detector, the heater transformer, and the heater failure indicating light.

2. Description

A. The heating elements consist of fine resistance wire sealed in the assembly, with provisions for external connection to ac power. The anti-icing heater and ammeter selector switch, located on the overhead switch panel, is a rotary-type switch. The switch connects power to the heater elements through the current sensing detector and heater transformer and also arms the failure indicating light circuit. When the switch is in any of the on positions, all the heaters are energized. The ammeter, located adjacent to the switch, indicates the electrical load of the heater corresponding to the switch position through the heater transformer. The current sensing detector, located in the EPC aft center equipment panel, consists of a transformer that supplies power to operate a relay coil, and contacts that interlock the failure indicating light circuit. The heater failure light is located on the overhead switch panel and is a push-to-test, dimmable, amber light. When the pitot heater switch is on, the light goes on if there is a malfunction in any of the pitot heaters except the flight recorder.

CAUTION: TO PROLONG SERVICE LIFE OF PITOT TUBE AND LIFT TRANSDUCER HEATING ELEMENTS, MAKE CERTAIN THAT ANTI-ICING HEATERS SWITCH IS TURNED OFF WHEN AIRPLANE IS ON GROUND.

B. The heating element for the static ports consist of an aluminum sleeve onto which is wound a heating element, with provisions for external connection to ac power. The heater switch connects power to the static port heater control relay and 115 vac is supplied to the heater element through the relay contacts.



Pitot and Static System -- Electrical Schematic
Figure 1

PITOT AND STATIC - DESCRIPTION AND OPERATION

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A. Ice protection is provided by electrical heating elements for the captain's, first officer's, alternate and flight recorder pitot tubes, stall warning lift transducer, outside air data sensors and the static ports. The anti-icing heating system is comprised of the pitot tube and static port heating elements, the heater for the stall warning lift transducer and outside air temperature sensors, the anti-icing heater and ammeter selector switch, the current sensing detector, the heater transformer, and the heater failure indicating light.

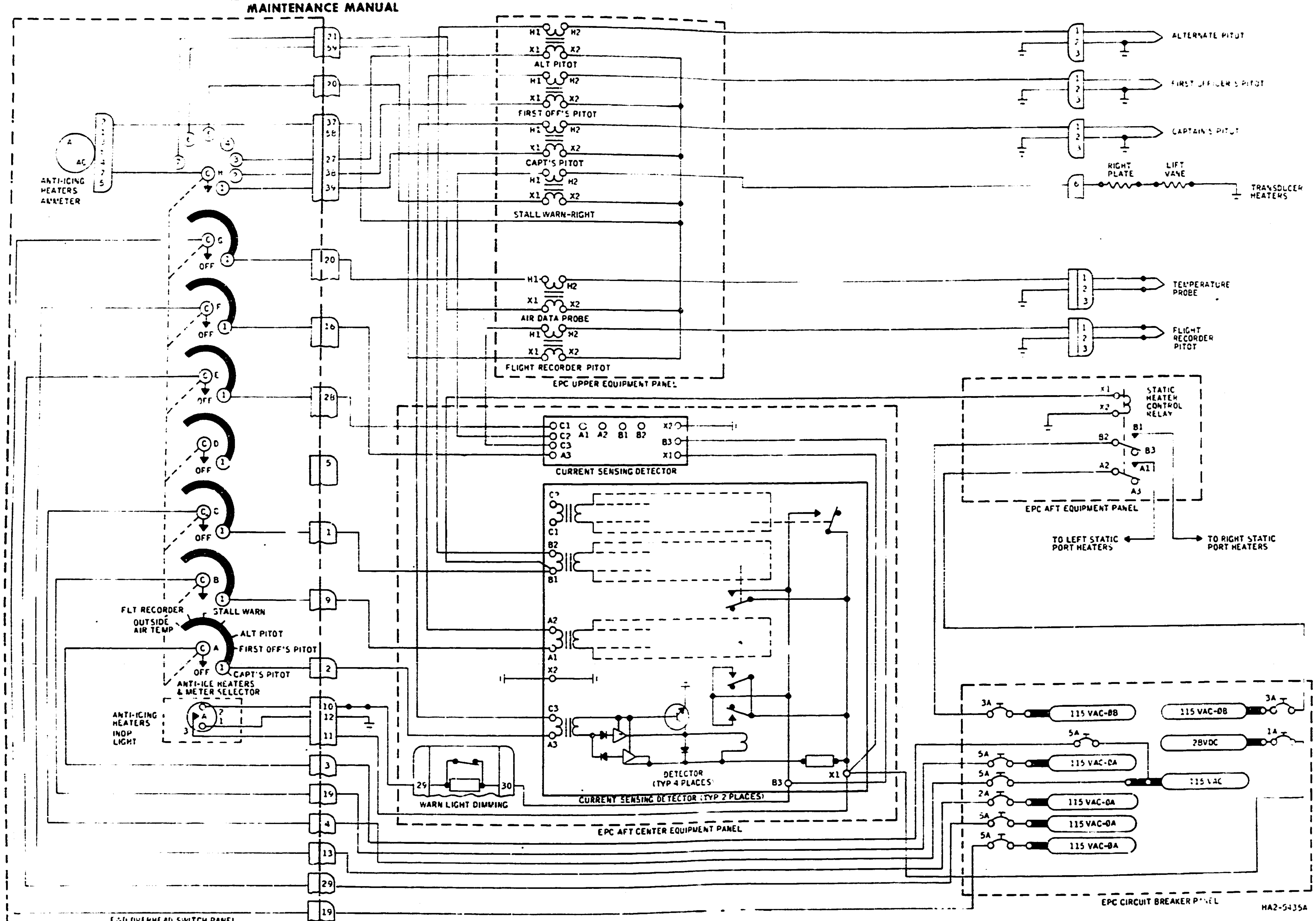
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CAUTION: TO PROLONG SERVICE LIFE OF PITOT TUBE AND LIFT TRANSDUCER HEATING ELEMENTS, MAKE CERTAIN THAT ANTI-ICING HEATERS SWITCH IS TURNED OFF WHEN AIRPLANE IS ON GROUND.

B. The heating element for the static ports consist of an aluminum sleeve onto which is wound a heating element, with provisions for external connection to ac power. The heater switch connects power to the static port heater control relay and 115 vac is supplied to the heater element through the relay contacts.

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Pitot and Static System -- Electrical Schematic
Figure 1

PITOT AND STATIC - TROUBLE SHOOTING

1. General

A. The trouble shooting procedures for all pitot tube heaters are identical. Procedures for the left and right static port heaters are also identical.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

2. Tools and Equipment Required

A. A multimeter, Simpson Model 260, or equivalent is required for voltage and continuity checks.

3. Trouble Shooting Pitot Tube Ice Protection Heaters

Possible Causes	Isolation Procedure	Correction
A. PITOT TUBE HEATER INOPERATIVE		
(1) Defective heating element.	With electrical power applied to all buses, and anti-icing heater switch in on position, check for 115-vac and ground at connector to pitot heater.	If normal, replace pitot tube (see Chapter 34). If no voltage exists, proceed to (2).
(2) Defective pitot heater warning relay.	Check for 115-vac through relay.	If normal, repair wiring between relay and pitot tube.
	Check for 115-vac at relay.	If normal, replace relay. If no voltage exists, proceed to (3).
(3) Defective anti-icing heater switch.	Check for 115-vac through switch.	If voltage is normal, repair wiring between switch and relay.
	Check for 115-vac at switch.	If normal, replace switch. If no voltage exists, proceed to (4).

Possible Causes	Isolation Procedure	Correction
A. PITOT TUBE HEATER INOPERATIVE (Continued)		
(4) Defective wiring or circuit breaker.	Open applicable pitot heater circuit breaker (115-vac). Check continuity between heater switch and circuit breaker (see Wiring Diagram Manual).	If no continuity exists, repair wiring or replace circuit breaker as required.

4. Trouble Shooting Static Port Ice Protection Heaters (Airplanes 860 and Subsequent)

Possible Causes	Isolation Procedure	Correction
A. STATIC PORT HEATER INOPERATIVE		
(1) Defective heating element.	With electrical power applied to all buses, and anti-icing heater switch in on position, check for 115-vac and ground at connector to static heater.	If normal, replace static port heater. If no voltage exists, proceed to (2).
(2) Defective static heater control relay.	Check for 115-vac through relay contacts.	If normal, repair wiring between relay and heater.
	Check for 115-vac at relay contacts.	If normal, replace relay. If no voltage exists, proceed to (3).
(3) Defective wiring or circuit breaker in heater circuit.	Open applicable static port heater circuit breaker (115-vac). Check continuity between heater control relay contacts and circuit breaker (see Wiring Diagram Manual).	If no continuity exists, repair wiring or replace circuit breaker as required. If continuity exists, proceed to (4).

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Possible Causes	Isolation Procedure	Correction
A. STATIC PORT HEATER INOPERATIVE (Continued)		
(4) Defective anti-icing heater switch.	Check for 115-vac through switch.	If normal, repair wiring between switch and relay.
	Check for 115-vac at switch.	If normal, replace switch.
		If no voltage exists, proceed to (5).
(5) Defective wiring or circuit breaker in heater control circuit.	Open alternate pitot heater circuit breaker (115-vac). Check continuity between heater switch and circuit breaker.	If no continuity exists, repair wiring or replace circuit breaker as required.

PITOT AND STATIC - TROUBLE SHOOTING

1. General

A. The trouble shooting procedures for all pitot tube heaters are identical. Procedures for the left and right static port heaters are also identical.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

2. Tools and Equipment Required

A. A multimeter, Simpson Model 260, or equivalent is required for voltage and continuity checks.

3. Trouble Shooting Pitot Tube Ice Protection Heaters

Possible Causes	Isolation Procedure	Correction
A. PITOT TUBE HEATER INOPERATIVE		
(1) Defective heating element.	With electrical power applied to all buses, and anti-icing heater switch in on position, check for 115-vac and ground at connector to pitot heater.	If normal, replace pitot tube (see Chapter 34). If no voltage exists, proceed to (2).
(2) Defective pitot heater warning relay.	Check for 115-vac through relay.	If normal, repair wiring between relay and pitot tube.
	Check for 115-vac at relay.	If normal, replace relay. If no voltage exists, proceed to (3).
(3) Defective anti-icing heater switch.	Check for 115-vac through switch.	If voltage is normal, repair wiring between switch and relay.
	Check for 115-vac at switch.	If normal, replace switch. If no voltage exists, proceed to (4).

Possible Causes	Isolation Procedure	Correction
A. PITOT TUBE HEATER INOPERATIVE (Continued)		
(4) Defective wiring or circuit breaker.	Open applicable pitot heater circuit breaker (115-vac). Check continuity between heater switch and circuit breaker (see Wiring Diagram Manual).	If no continuity exists, repair wiring or replace circuit breaker as required.

4. Trouble Shooting Static Port Ice Protection Heaters

Possible Causes	Isolation Procedure	Correction
A. STATIC PORT HEATER INOPERATIVE		
(1) Defective heating element.	With electrical power applied to all buses, and anti-icing heater switch in on position, check for 115-vac and ground at connector to static heater.	If normal, replace static port heater. If no voltage exists, proceed to (2).
(2) Defective static heater control relay.	Check for 115-vac through relay contacts.	If normal, repair wiring between relay and heater.
	Check for 115-vac at relay contacts.	If normal, replace relay. If no voltage exists, proceed to (3).
(3) Defective wiring or circuit breaker in heater circuit.	Open applicable static port heater circuit breaker (115-vac). Check continuity between heater control relay contacts and circuit breaker (see Wiring Diagram Manual).	If no continuity exists, repair wiring or replace circuit breaker as required. If continuity exists, proceed to (4).

Possible Causes	Isolation Procedure	Correction
A. STATIC PORT HEATER INOPERATIVE (Continued)		
(4) Defective anti-icing heater switch.	Check for 115-vac through switch.	If normal, repair wiring between switch and relay.
	Check for 115-vac at switch.	If normal, replace switch.
		If no voltage exists, proceed to (5).
(5) Defective wiring or circuit breaker in heater control circuit.	Open alternate pitot heater circuit breaker (115-vac). Check continutiy between heater switch and circuit breaker.	If no continuity exists, repair wiring or replace circuit breaker as required.

PITOT AND STATIC - TROUBLE SHOOTING

1. General

A. The trouble shooting procedures for all pitot tube heaters are identical. Procedures for the left and right static port heaters are also identical.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

2. Tools and Equipment Required

A. A multimeter, Simpson Model 260, or equivalent is required for voltage and continuity checks.

3. Trouble Shooting Pitot Tube Ice Protection Heaters

Possible Causes	Isolation Procedure	Correction
A. PITOT TUBE HEATER INOPERATIVE		
(1) Defective heating element.	With electrical power applied to all buses, and anti-icing heater and ammeter selector switch in any of the on positions, check for 115-vac and ground at connector to heater.	If normal, replace pitot tube (see Chapter 34). If no voltage exists, proceed to (2).
(2) Defective pitot heater transformer	Check for 115-vac through transformer.	If normal, repair wiring between transformer and pitot tube.
	Check for 115-vac at transformer.	If normal, replace transformer. If no voltage exists, proceed to (3).
(3) Defective current sensing detector.	Check for 115-vac through detector.	If normal, repair wiring between detector and transformer.
	Check for 115-vac at detector.	If normal, replace detector. If no voltage exists, proceed to (4).

	Possible Causes	Isolation Procedure	Correction
A.	PITOT TUBE HEATER INOPERATIVE (Continued)		
(4)	Defective anti-icing heater and ammeter selector switch.	Check for 115-vac through switch.	If voltage is normal, repair wiring between switch and detector.
		Check for 115-vac at switch.	If normal, replace switch.
			If no voltage exists, proceed to (5).
(5)	Defective wiring or circuit breaker.	Open applicable pitot heater circuit breaker (115-vac). Check continuity between switch and circuit breaker (see Wiring Diagram Manual).	If no continuity exists, repair wiring or replace circuit breaker as required.
B.	NO AMMETER INDICATION: CORRESPONDING HEATER IS FUNCTIONING		
(1)	No ammeter indication for any switch position.	None	Replace ammeter.
(2)	No ammeter indication for a specific heater switch position.	Check continuity of respective transformer and/or wiring through selector switch.	Replace transformer, or repair wiring.

4. Trouble Shooting Static Port Ice Protection Heaters

	Possible Causes	Isolation Procedure	Correction
A.	STATIC PORT HEATER INOPERATIVE		
(1)	Defective heating element.	With electrical power applied to all buses, and anti-icing heater and ammeter selector switch in any of the on positions, check for 115-vac and ground at connector to static heater.	If normal, replace static port heater. If no voltage exists, proceed to (2).

Possible Causes	Isolation Procedure	Correction
A. STATIC PORT HEATER INOPERATIVE (Continued)		
(2) Defective static heater control relay.	Check for 115-vac through relay contacts.	If normal, repair wiring between relay and heater.
	Check for 115-vac at relay contacts.	If normal, replace relay.
		If no voltage exists, proceed to (3).
(3) Defective wiring or circuit breaker in heater circuit.	Open applicable static port heater circuit breaker (115-vac). Check continuity between heater control relay contacts and circuit breaker (see Wiring Diagram Manual).	If no continuity exists, repair wiring or replace circuit breaker as required.
		If continuity exists, proceed to (4).
(4) Defective anti-icing heater and ammeter selector switch.	Check for 115-vac through switch.	If normal, repair wiring between switch and relay.
	Check for 115-vac at switch.	If normal, replace switch.
		If no voltage exists, proceed to (5).
(5) Defective wiring or circuit breaker in heater control circuit.	Open alternate pitot heater circuit breaker (115-vac). Check continuity between heater switch and circuit breaker.	If no continuity exists, repair wiring or replace circuit breaker as required.

PITOT AND STATIC - MAINTENANCE PRACTICES

1. General

A. The anti-icing heaters and ammeter selector switch, and the anti-icing heaters ammeter are located in the flight compartment on the overhead switch panel. The right side static ports are located on the lower fuselage aft of the forward galley service door; left side static ports are opposite. The pitot tubes are located on the upper part of the fuselage nose section, forward of the windshield.

B. Access to the static port heaters is through the side panels of the lower forward cargo compartment.

C. Removal, installation and test procedures for each static port heater is identical. Test procedure for each pitot tube heater is identical. For removal and installation of pitot tube see Chapter 34.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

2. Removal/Installation Static Port Ice Protection Heater

A. Remove Heater

(1) Open applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from heater.

(3) Disconnect pressure line to static port.

(4) Remove nut and washer from static port.

(5) Remove heater.

B. Install Heater

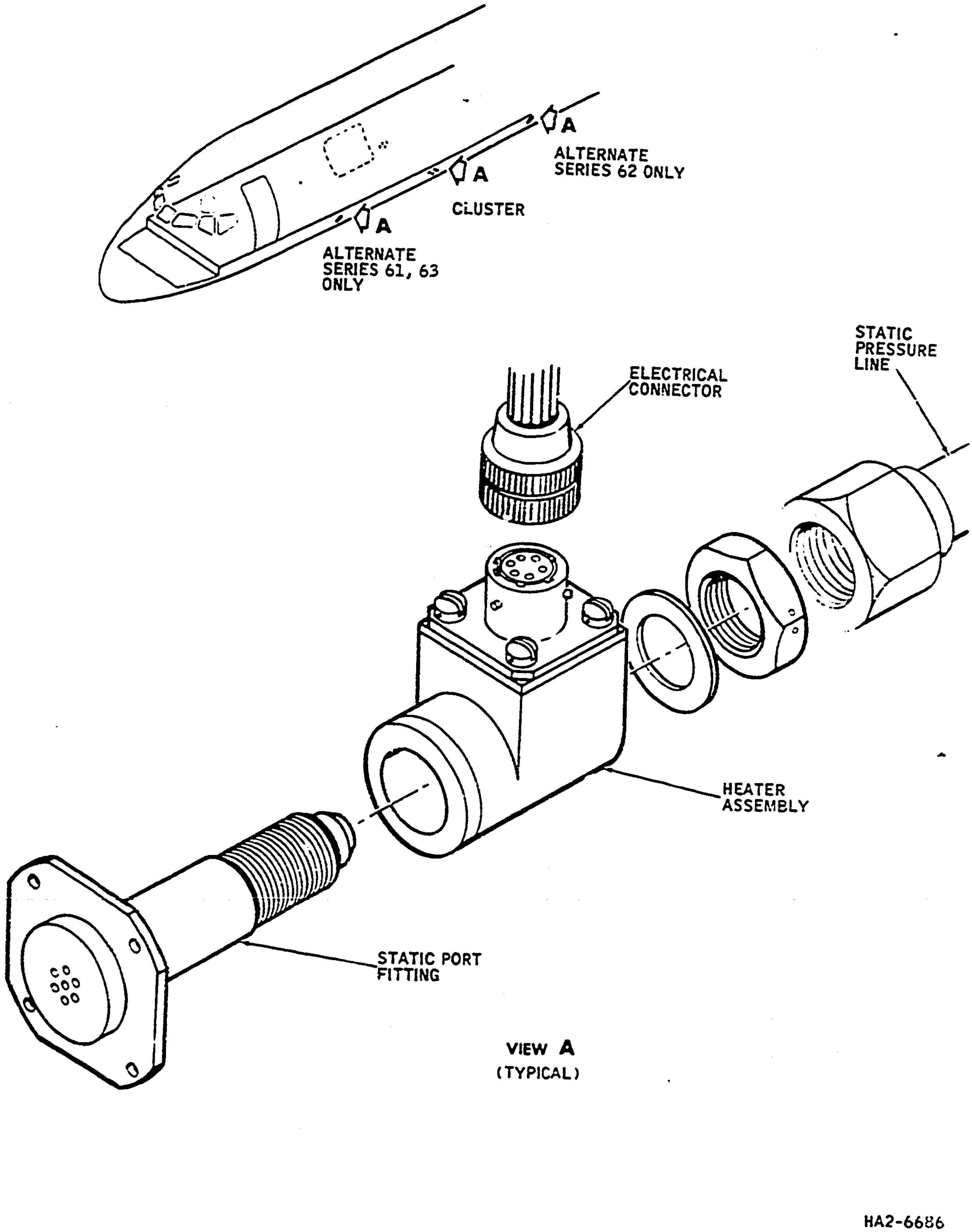
(1) Make certain applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel is open.

(2) Install heater on static port with arrow pointed outboard.

(3) Install nut and washer on static port.

(4) Connect pressure line.

(5) Connect electrical connector.



Static Port Heater -- Installation
Figure 201

(6) Close applicable static port heater circuit breaker located on heat, vent, and ice protection (ac) bus section of EPC circuit breaker panel.

(7) Test heater (see Paragraph 3).

3. Adjustment/Test Pitot and Static System

A. Test Anti-Icing Heaters

(1) Place anti-icing heaters and ammeter selector switch in on positions indicated below. Check ammeter indication and heater temperatures (after 1 minute of continuous operation) for each position, and check that the static port heaters function in all switch positions.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

Switch Position	Ammeter Indication (amperes)		Heater Temperature
	Minimum	Maximum	
Off	0	0	Ambient
Captain pitot	1.75	2.75	Hot
First officer pitot	1.75	2.75	Hot
Alternate pitot	1.75	2.50	Hot
Stall warning	1.50	2.50	Hot
Off	0	0	Cools to ambient

PITOT AND STATIC - MAINTENANCE PRACTICES

1. General

   A. The anti-icing heaters and ammeter selector switch, and the anti-icing heaters ammeter are located in the flight compartment on the overhead switch panel. The right side static ports are located on the lower fuselage aft of the forward galley service door; left side static ports are opposite. The pitot tubes are located on the upper part of the fuselage nose section, forward of the windshield.

   B. Access to the static port heaters is through the side panels of the lower forward cargo compartment.

   C. Removal, installation and test procedures for each static port heater is identical. Test procedure for each pitot tube heater is identical. For removal and installation of pitot tube see Chapter 34.

   WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

2. Removal/Installation Static Port Ice Protection Heater

   A. Remove Heater

      (1) Open applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

      (2) Disconnect electrical connector from heater.

      (3) Disconnect pressure line to static port.

      (4) Remove nut and washer from static port.

      (5) Remove heater.

   B. Install Heater

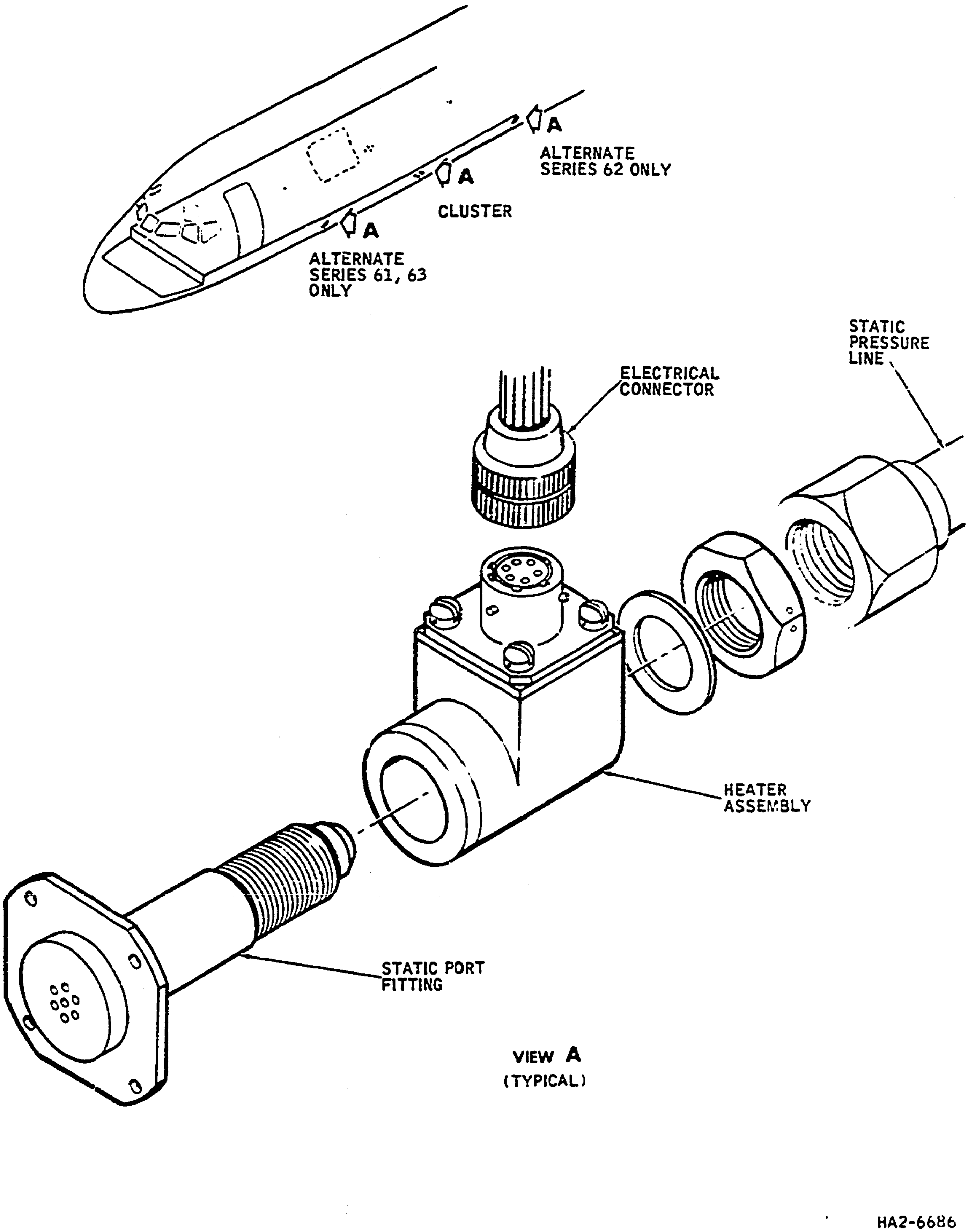
      (1) Make certain applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel is open.

      (2) Install heater on static port with arrow pointed outboard.

      (3) Install nut and washer on static port.

      (4) Connect pressure line.

      (5) Connect electrical connector.



Static Port Heater -- Installation
Figure 201

(6) Close applicable static port heater circuit breaker located on heat, vent, and ice protection (ac) bus section of EPC circuit breaker panel.

(7) Test heater (see Paragraph 3).

3. Adjustment/Test Pitot and Static System

A. Test Anti-Icing Heaters

(1) Place anti-icing heaters and ammeter selector switch in on positions indicated below. Check ammeter indication and heater temperatures (after 1 minute of continuous operation) for each position, and check that the static port heaters function in all switch positions.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

Switch Position	Ammeter Indication (amperes)		Heater Temperature
	Minimum	Maximum	
Off	0	0	Ambient
Captain pitot	1.75	2.75	Hot
First officer pitot	1.75	2.75	Hot
Alternate pitot	1.75	2.50	Hot
Stall warning	1.50	2.50	Hot
Flight Recorder pitot	1.00	1.50	Hot
Speed Command right	1.50	2.50	Hot
Speed Command left	1.50	2.50	Hot
Outside Air Temperature	1.20	2.20	Hot
Off	0	0	Cools to ambient

PITOT AND STATIC - MAINTENANCE PRACTICES

1. General

A. The anti-icing heaters and ammeter selector switch, and the anti-icing heaters ammeter are located in the flight compartment on the overhead switch panel. The right side static ports are located on the lower fuselage aft of the forward galley service door; left side static ports are opposite. The pitot tubes are located on the upper part of the fuselage nose section, forward of the windshield.

B. Access to the static port heaters is through the side panels of the lower forward cargo compartment.

C. Removal, installation and test procedures for each static port heater is identical. Test procedure for each pitot tube heater is identical. For removal and installation of pitot tube see Chapter 34.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

2. Removal/Installation Static Port Ice Protection Heater

A. Remove Heater

(1) Open applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from heater.

(3) Disconnect pressure line to static port.

(4) Remove nut and washer from static port.

(5) Remove heater.

B. Install Heater

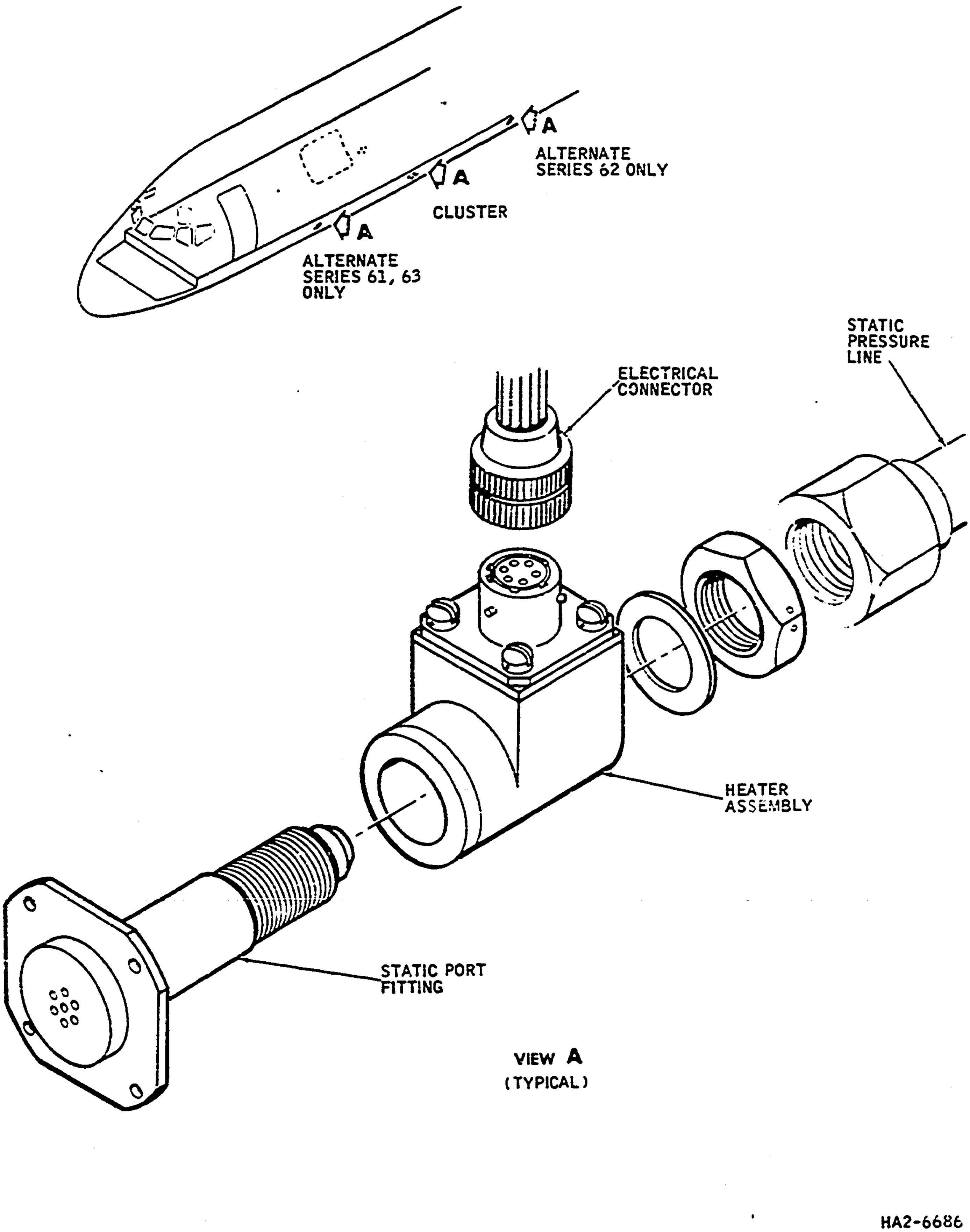
(1) Make certain applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel is open.

(2) Install heater on static port with arrow pointed outboard.

(3) Install nut and washer on static port.

(4) Connect pressure line.

(5) Connect electrical connector.



Static Port Heater -- Installation
Figure 201

(6) Close applicable static port heater circuit breaker located on heat, vent, and ice protection (ac) bus section of EPC circuit breaker panel.

(7) Test heater (see Paragraph 3).

3. Adjustment/Test Pitot and Static System

A. Test Anti-Icing Heaters

(1) Place anti-icing heaters and ammeter selector switch in on positions indicated below. Check ammeter indication and heater temperatures (after 1 minute of continuous operation) for each position, and check that the static port heaters function in all switch positions.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

Switch Position	Ammeter Indication (amperes)		Heater Temperature
	Minimum	Maximum	
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First officer pitot	1.75	2.75	Hot
Alternate pitot	1.75	2.50	Hot
Stall warning	1.50	2.50	Hot
Flight Recorder pitot	1.00	1.50	Hot
Outside Air temperature	1.20	2.20	Hot
Off	0	0	Cools to ambient

PITOT AND STATIC - MAINTENANCE PRACTICES

1. General

A. The anti-icing heaters and ammeter selector switch, and the anti-icing heaters ammeter are located in the flight compartment on the overhead switch panel. The right side static ports are located on the lower fuselage aft of the forward galley service door; left side static ports are opposite. The pitot tubes are located on the upper part of the fuselage nose section, forward of the windshield.

B. Access to the static port heaters is through the side panels of the lower forward cargo compartment.

C. Removal, installation and test procedures for each static port heater is identical. Test procedure for each pitot tube heater is identical. For removal and installation of pitot tube see Chapter 34.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

2. Removal/Installation Static Port Ice Protection Heater

A. Remove Heater

(1) Open applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from heater.

(3) Disconnect pressure line to static port.

(4) Remove nut and washer from static port.

(5) Remove heater.

B. Install Heater

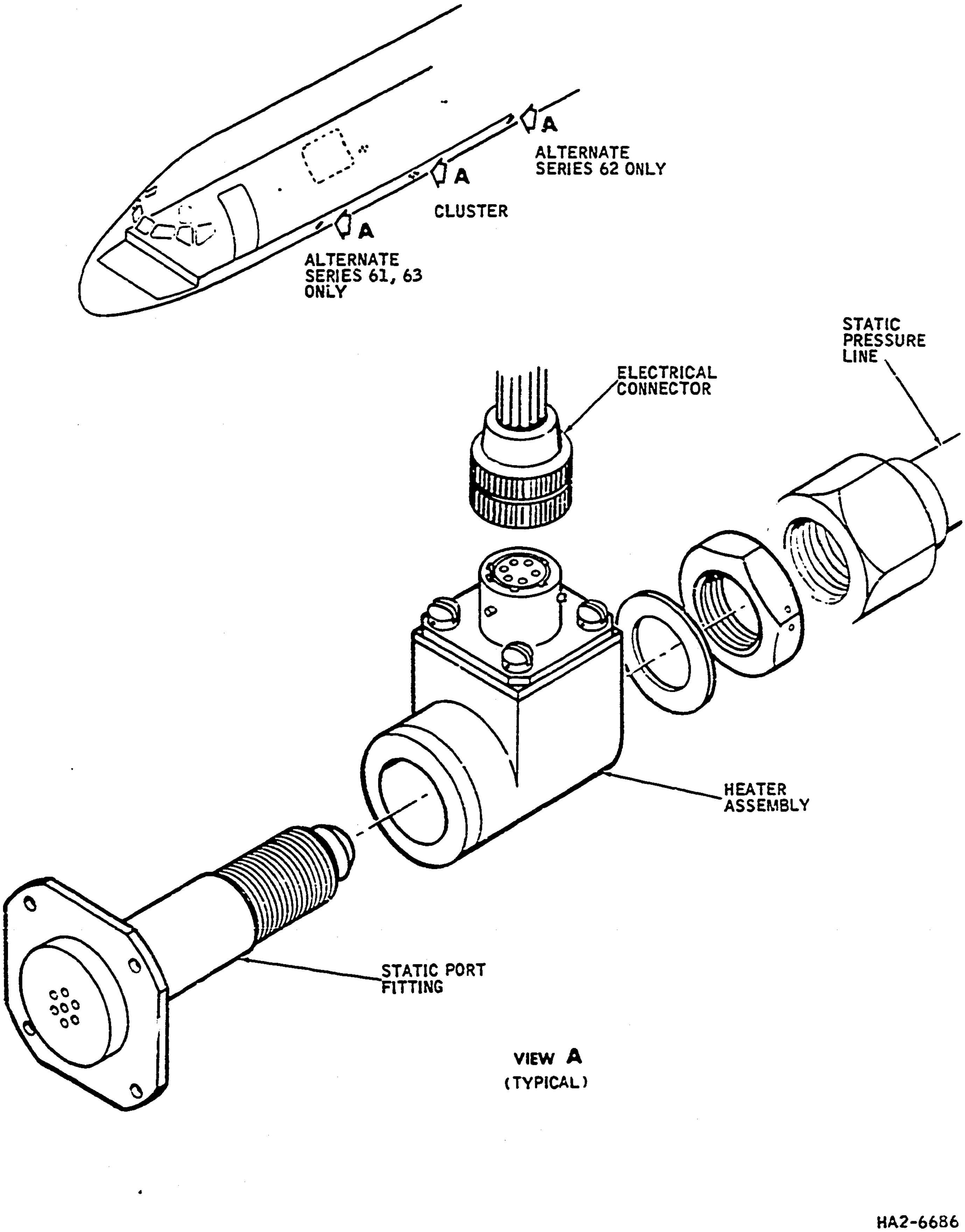
(1) Make certain applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel is open.

(2) Install heater on static port with arrow pointed outboard.

(3) Install nut and washer on static port.

(4) Connect pressure line.

(5) Connect electrical connector.



Static Port Heater -- Installation
Figure 201

(6) Close applicable static port heater circuit breaker located on heat, vent, and ice protection (ac) bus section of EPC circuit breaker panel.

(7) Test heater (see Paragraph 3).

3. Adjustment/Test Pitot and Static System

A. Test Anti-Icing Heaters

(1) Place anti-icing heaters and ammeter selector switch in on positions indicated below. Check ammeter indication and heater temperatures (after 1 minute of continuous operation) for each position, and check that the static port heaters function in all switch positions.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

Switch Position	Ammeter Indication (amperes)		Heater Temperature
	Minimum	Maximum	
Off	0	0	Ambient
Captain pitot	1.75	2.75	Hot
First officer pitot	1.75	2.75	Hot
Alternate pitot	1.75	2.50	Hot
Stall warning	1.50	2.50	Hot
Flight Recorder pitot	1.00	1.50	Hot
Off	0	0	Cools to ambient

PITOT AND STATIC - MAINTENANCE PRACTICES

1. General

A. The anti-icing heaters switch, and the anti-icing heater failure warning lights are located in the flight compartment on the overhead switch panel. The right side static ports are located on the lower fuselage aft of the forward galley service door; left side static ports are opposite. The pitot tubes are located on the upper part of the fuselage nose section, forward of the windshield.

B. Access to the static port heaters is through the side panels of the lower forward cargo compartment.

C. Removal, installation and test procedures for each static port heater is identical. Test procedure for each pitot tube heater is identical. For removal and installation of pitot tube see Chapter 34.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

2. Removal/Installation Static Port Ice Protection Heater

A. Remove Heater

(1) Open applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from heater.

(3) Disconnect pressure line to static port.

(4) Remove nut and washer from static port.

(5) Remove heater.

B. Install Heater

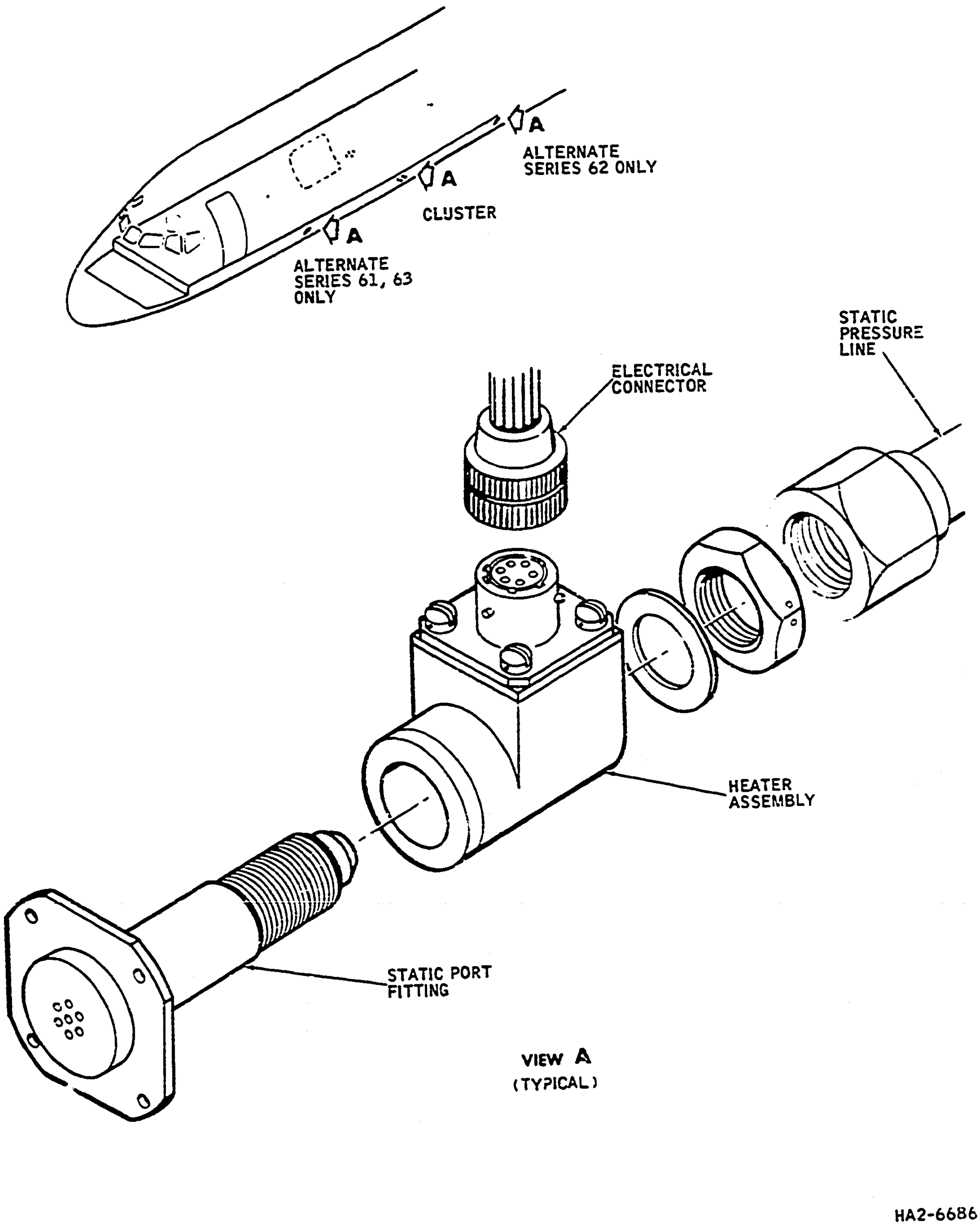
(1) Make certain applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel is open.

(2) Install heater on static port with arrow pointed outboard.

(3) Install nut and washer on static port.

(4) Connect pressure line.

(5) Connect electrical connector.



Static Port Heater -- Installation
Figure 201

(6) Close applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(7) Test heater (see Paragraph 3).

3. Adjustment/Test Pitot and Static System

A. Test Anti-icing Heaters

(1) Open following circuit breakers located on EPC circuit breaker panel:

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First Officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous (ac bus)

(2) Push applicable hea[illegible] failure push-to-test indicating lights. Lights should come on when pressed, and go off when released.

(3) Place anti-icing heaters switch in on position. All heater failure indicating lights should come on.

(4) Close applicable heater circuit breaker. Check corresponding pitot tube for an increase in temperature. Corresponding heater failure indicating light should be off.

(5) Open applicable heater circuit breaker. Corresponding pitot failure light should come on.

(6) Close stall warning control and heater circuit breaker. Check stall warning lift transducer for an increase in temperature. Stall warning heater failure indicating light should be off.

(7) Check that static port heaters are hot.

(8) Place anti-icing heaters switch in off position.

(9) Close following circuit breakers:

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First Officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus

PITOT AND STATIC - MAINTENANCE PRACTICES

1. General

A. The anti-icing heaters switch, and the anti-icing heater failure warning lights are located in the flight compartment on the overhead switch panel. The right side static ports are located on the lower fuselage aft of the forward galley service door; left side static ports are opposite. The pitot tubes are located on the upper part of the fuselage nose section, forward of the windshield.

B. Access to the static port heaters is through the side panels of the lower forward cargo compartment.

C. Removal, installation and test procedures for each static port heater is identical. Test procedure for each pitot tube heater is identical. For removal and installation of pitot tube see Chapter 34.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

2. Removal/Installation Static Port Ice Protection Heater (Airplanes 860 and Subsequent

A. Remove Heater

(1) Open applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(2) Disconnect electrical connector from heater.

(3) Disconnect pressure line to static port.

(4) Remove nut and washer from static port.

(5) Remove heater.

B. Install Heater

(1) Make certain applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel is open.

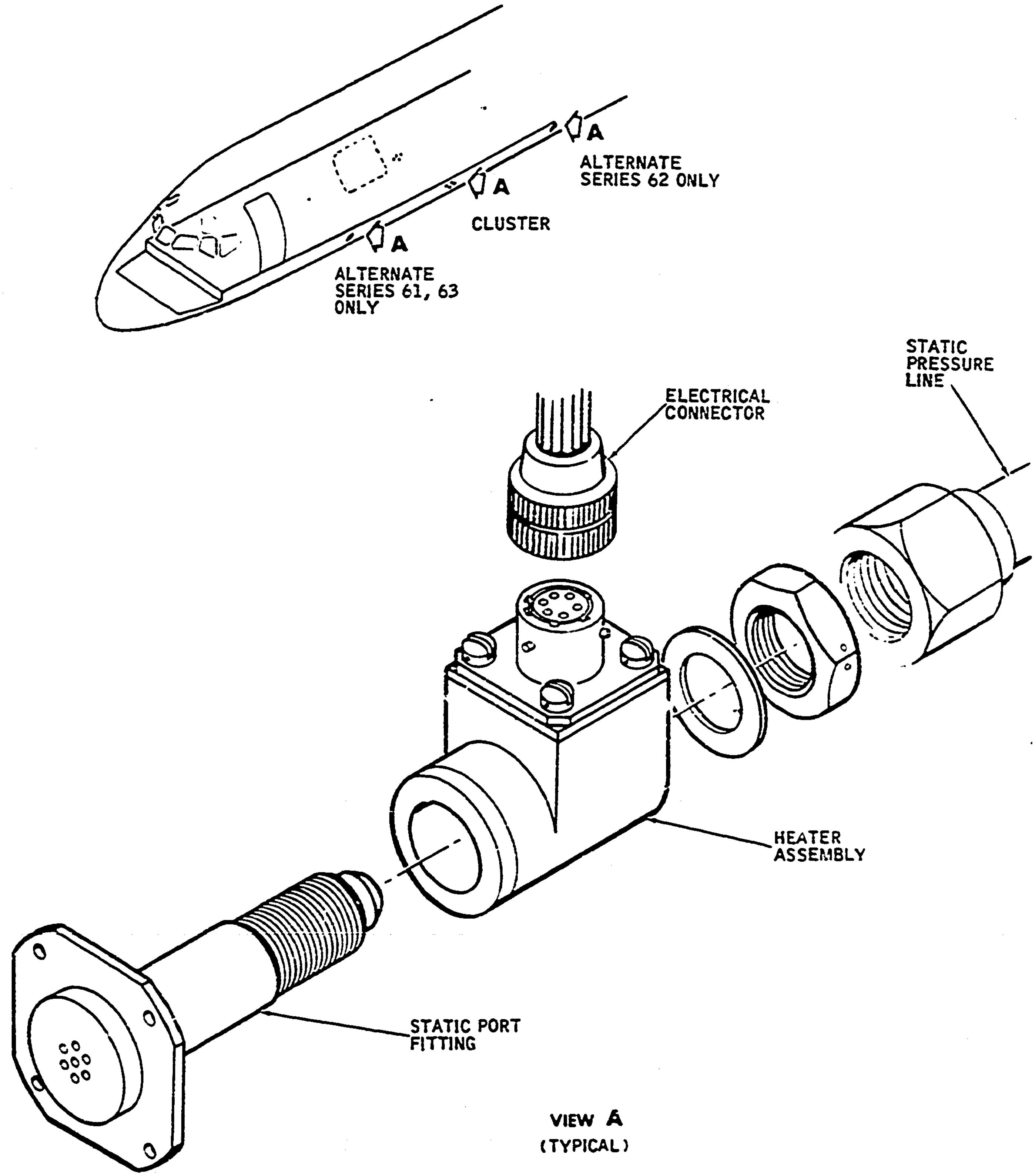
(2) Install heater on static port with arrow pointed outboard.

(3) Install nut and washer on static port.

(4) Connect pressure line.

(5) Connect electrical connector.

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Static Port Heater--Installation
(Airplanes 860 and Subsequent)
Figure 201

(6) Close applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

(7) Test heater (see Paragraph 3).

3. Adjustment/Test Pitot and Static System

A. Test Anti-icing Heaters

(1) Open following circuit breakers located on EPC circuit breaker panel:

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First Officer's pitot heater	Right ac emergency bus
Alternate pitot heater (817 and subsequent)	Left ac emergency bus
Stall warning control and heater	Miscellaneous (ac bus)

(2) Push applicable heater failure push-to-test indicating lights. Lights should come on when pressed, and go off when released.

(3) Place anti-icing heaters switch in on position. All heater failure indicating lights should come on.

(4) Close applicable heater circuit breaker. Check corresponding pitot tube for an increase in temperature. Corresponding heater failure indicating light should be off.

(5) Open applicable heater circuit breaker. Corresponding pitot failure light should come on.

(6) Close stall warning control and heater circuit breaker. Check stall warning lift transducer for an increase in temperature. Stall warning heater failure indicating light should be off.

(7) On airplanes 860 and subsequent, check that static port heaters are hot.

(8) Place anti-icing heaters switch in off position.

(9) Close following circuit breakers:

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First Officers's pitot heater	Right ac emergency bus
Alternate pitot heater (817 and subsequent)	Left ac emergency bus

PITOT AND STATIC - MAINTENANCE PRACTICES

1. General

   A. The anti-icing heaters and ammeter selector switch, and the anti-icing heaters ammeter are located in the flight compartment on the overhead switch panel. The right side static ports are located on the lower fuselage aft of the forward galley service door; left side static ports are opposite. The pitot tubes are located on the upper part of the fuselage nose section, forward of the windshield.

   B. Access to the static port heaters is through the side panels of the lower forward cargo compartment.

   C. Removal, installation and test procedures for each static port heater is identical. Test procedure for each pitot tube heater is identical. For removal and installation of pitot tube see Chapter 34.

   WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

2. Removal/Installation Static Port Ice Protection Heater

   A. Remove heater

      (1) Open applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

      (2) Disconnect electrical connector from heater.

      (3) Disconnect pressure line to static port.

      (4) Remove nut and washer from static port.

      (5) Remove heater.

   B. Install Heater

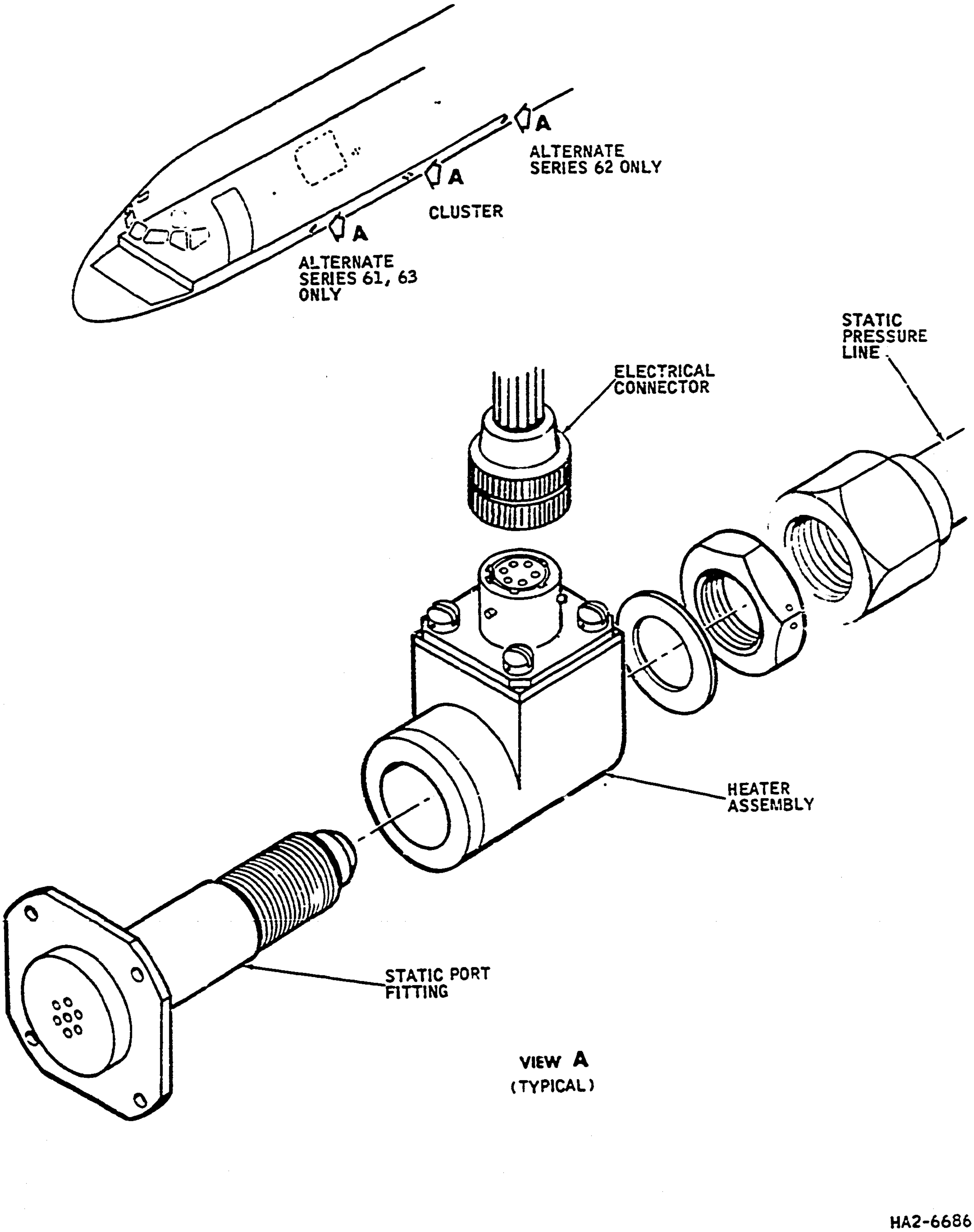
      (1) Make certain applicable static port heater circuit breaker located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel is open.

      (2) Install heater on static port with arrow pointed outboard.

      (3) Install nut and washer on static port.

      (4) Connect pressure line.

      (5) Connect electrical connector.



Static Port Heater -- Installation
Figure 201

(6) Close applicable static port heater circuit breaker located on heat, vent, and ice protection (ac) bus section of EPC circuit breaker panel.

(7) Test heater (see Paragraph 3).

3. Adjustment/Test Pitot and Static System

A. Test Anti-Icing Heaters

(1) Place anti-icing heaters and ammeter selector switch in on positions indicated below. Check ammeter indication and heater temperatures (after 1 minute of continuous operation) for each position, and check that the static port heaters function in all switch positions.

WARNING: DO NOT TOUCH AN ENERGIZED HEATER.

Switch Position	Ammeter Indication (amperes)		Heater Temperature
	Minimum	Maximum	
Off	0	0	Ambient
Captain pitot	1.75	2.75	Hot
First officer pitot	1.75	2.75	Hot
Alternate pitot	1.75	2.50	Hot
Stall warning	1.50	2.50	Hot
Left outside air temperature	1.20	2.20	Hot
Right outside air temperature	1.20	2.20	Hot
Off	0	0	Cools to ambient

ANTI-ICING HEATERS AND AMMETER SELECTOR SWITCH - MAINTENANCE PRACTICES

1. General

   A. The anti-icing heaters and ammeter selector switch is located in the flight compartment on the overhead switch panel, adjacent to the ammeter.

2. Removal/Installation Anti-Icing Heaters and Ammeter Selector Switch

   A. Remove Selector Switch

      (1) Open following circuit breakers located on EPC circuit breaker panel.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous (ac bus)

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 13).

      (2) Remove overhead switch panel (see Chapter 31).

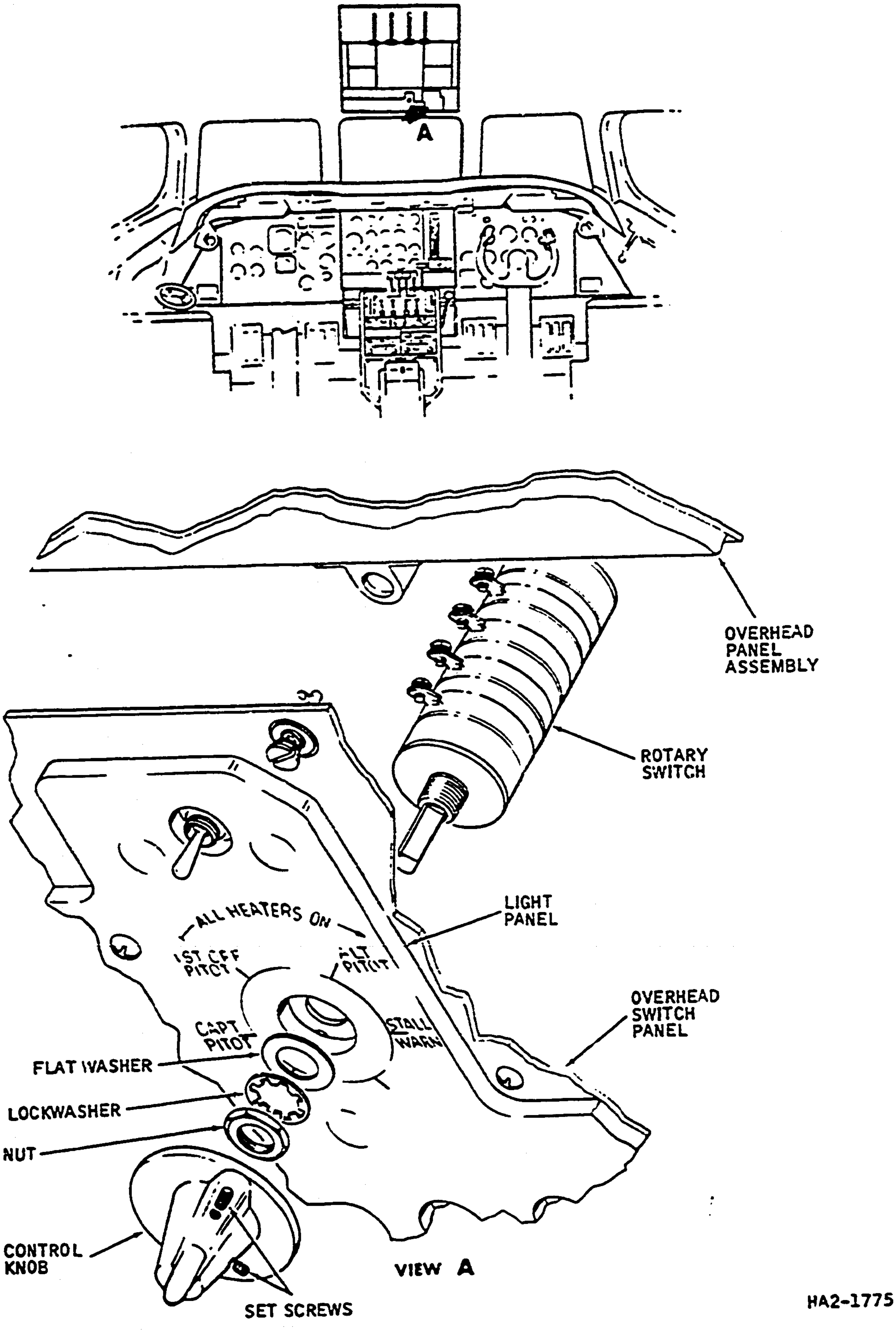
      (3) Disconnect and tag wires at rear of switch.

      (4) Remove switch.

   B. Install Selector Switch

      (1) Make certain that following circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus



Anti-Icing Heaters and Ammeter Selector Switch -- Installation
Figure 201

Circuit Breaker	Panel Section
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus

(2) Install switch on overhead switch panel.

(3) Remove tags and connect wires to switch.

(4) Install overhead switch panel (see Chapter 31).

(5) Close following circuit breakers.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus

3. Adjustment/Test Anti-Icing Heaters and Ammeter Selector Switch

A. To test heaters and ammeter selector switch, perform pitot and static system test (see 30-30-0, Maintenance Practices).

ANTI-ICING HEATERS AND AMMETER SELECTOR SWITCH - MAINTENANCE PRACTICES

1. General

   A. The anti-icing heaters and ammeter selector switch is located in the flight compartment on the overhead switch panel, adjacent to the ammeter.

2. Removal/Installation Anti-Icing Heaters and Ammeter Selector Switch

   A. Remove Selector Switch

      (1) Open following circuit breakers located on EPC circuit breaker panel.

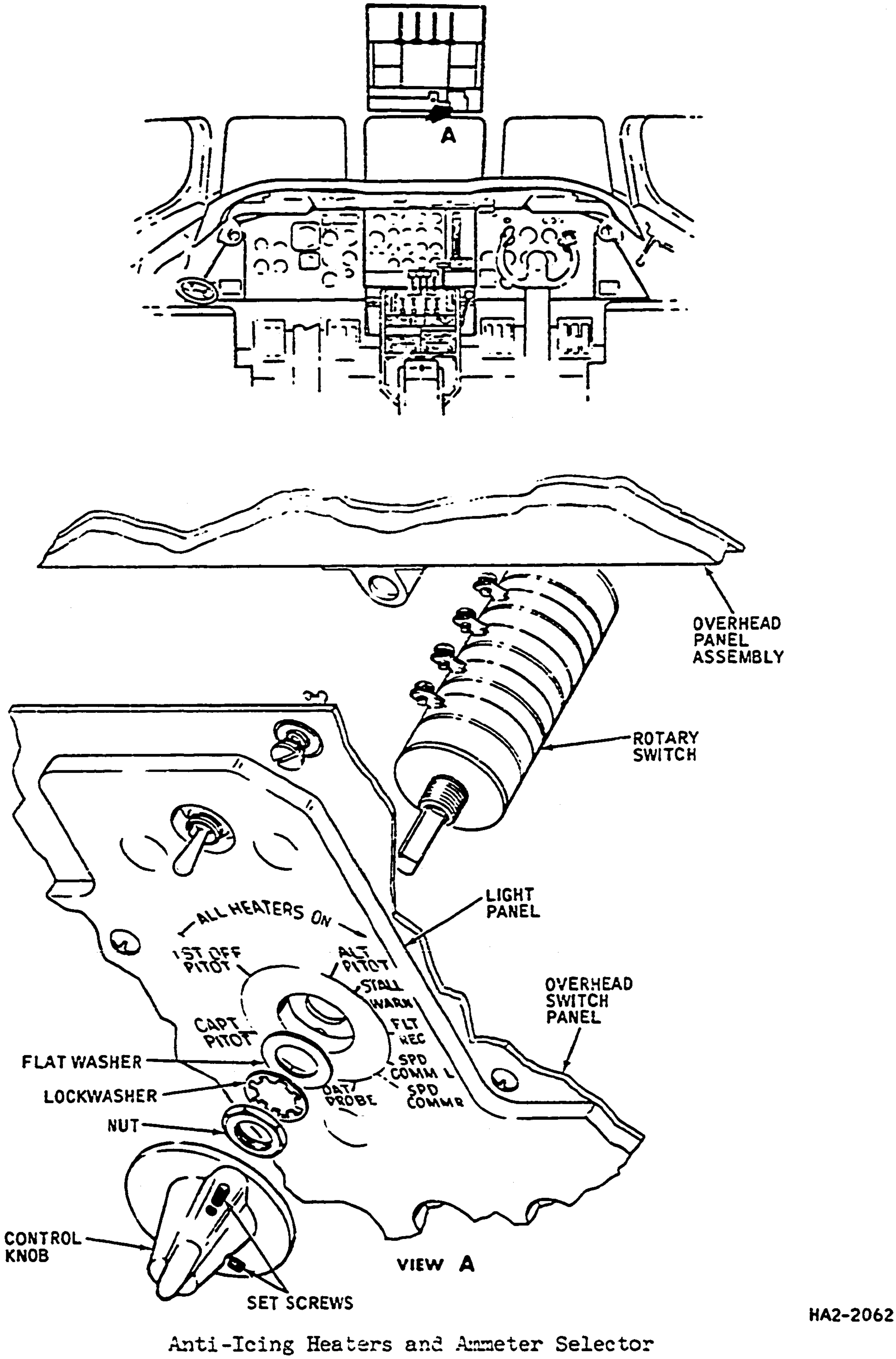
Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's and flight recorder pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous (ac bus)
Speed command right	Left ac emergency bus
Speed command left	Left ac emergency bus
Ram air temperature	Right ac emergency bus

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 13).

      (2) Remove overhead switch panel (see Chapter 31).

      (3) Disconnect and tag wires at rear of switch.

      (4) Remove switch.



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Anti-Icing Heaters and Ammeter Selector
Switch -- Installation
Figure 201

B. Install Selector Switch

(1) Make certain that following circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's and flight recorder pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Speed command right	Left ac emergency bus
Speed command left	Left ac emergency bus
Ram air temperature	Right ac emergency bus

(2) Install switch on overhead switch panel.

(3) Remove tags and connect wires to switch.

(4) Install overhead switch panel (see Chapter 31).

(5) Close following circuit breakers.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's and flight recorder pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Speed command right	Left ac emergency bus
Speed command left	Left ac emergency bus
Ram air temperature	Right ac emergency bus

3. Adjustment/Test Anti-Icing Heaters and Ameter Selector Switch

A. To test heaters and ammeter selector switch, perform pitot and static system test (see 30-30-0, Maintenance Practices).

ANTI-ICING HEATERS AND AMMETER SELECTOR SWITCH - MAINTENANCE PRACTICES

1. General

A. The anti-icing heaters and ammeter selector switch is located in the flight compartment on the overhead switch panel, adjacent to the ammeter.

2. Removal/Installation Anti-Icing Heaters and Ammeter Selector Switch

A. Remove Selector Switch

(1) Open following circuit breakers located on EPC circuit breaker panel.

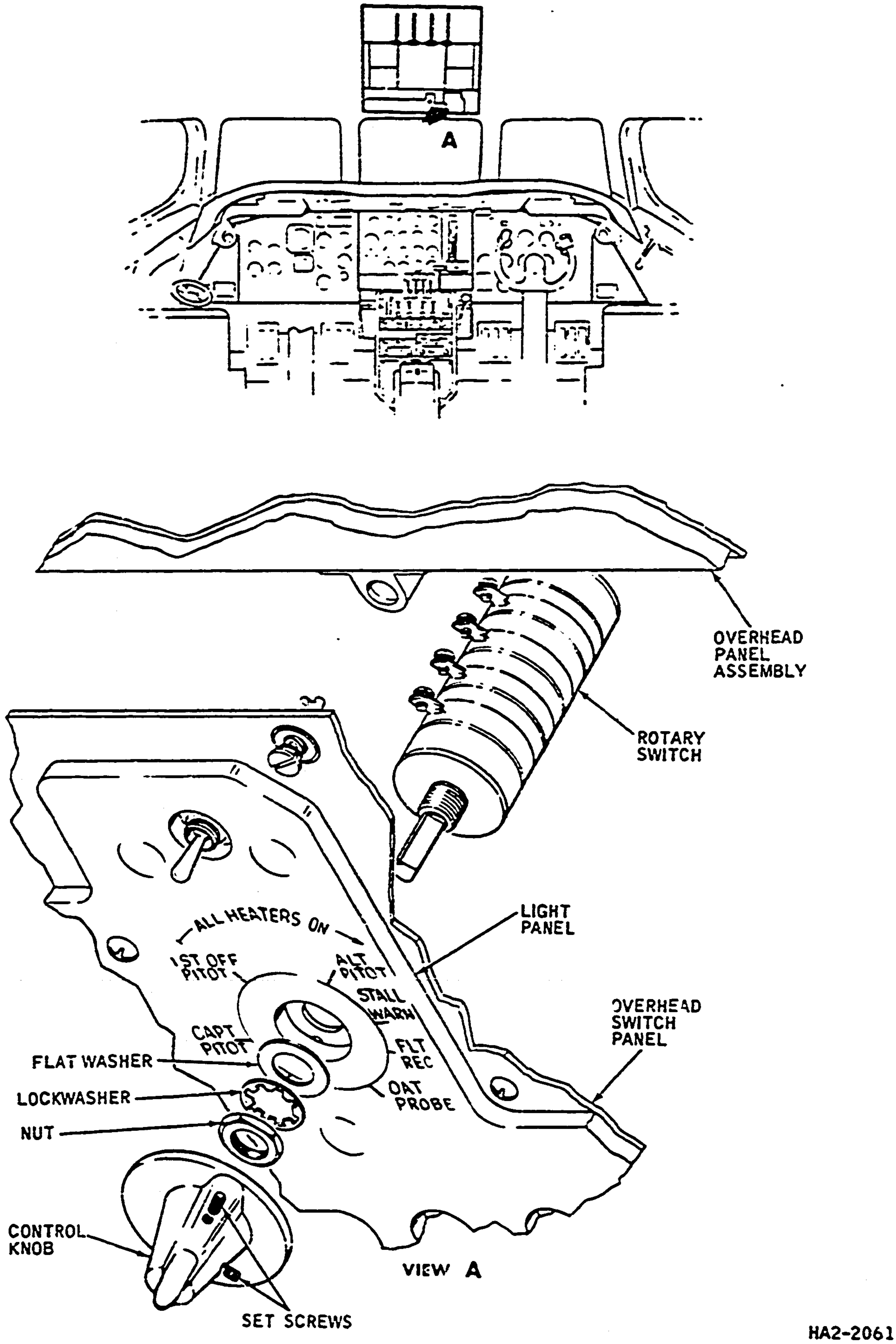
Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous (ac bus)
Flight recorder pitot heater	Right ac emergency bus
Ram air temperature	Heat, vent and ice protection (ac bus)

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 13).

(2) Remove overhead switch panel (see Chapter 31).

(3) Disconnect and tag wires at rear of switch.

(4) Remove switch.



Anti-Icing Heaters and Ammeter Selector
Switch -- Installation
Figure 201

B. Install Selector Switch

(1) Make certain that following circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Flight recorder pitot heater	Right ac emergency bus
Ram air temperature	Heat, vent and ice protection (ac bus)

(2) Install switch on overhead switch panel.

(3) Remove tags and connect wires to switch.

(4) Install overhead switch panel (see Chapter 31).

(5) Close following circuit breakers.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Flight recorder pitot heater	Right ac emergency bus
Ram air temperature	Heat, vent and ice protection (ac bus)

3. <u>Adjustment/Test Anti-Icing Heaters and Ammeter Selector Switch</u>

A. To test heaters and ammeter selector switch, perform pitot and static system test (see 30-30-0, Maintenance Practices).

ANTI-ICING HEATERS AND AMMETER SELECTOR SWITCH - MAINTENANCE PRACTICES

1. General

   A. The anti-icing heaters and ammeter selector switch is located in the flight compartment switch panel, adjacent to the ammeter.

2. Removal/Installation Anti-Icing Heaters and Ammeter Selector Switch

   A. Remove Selector Switch

      (1) Open following circuit breakers located on EPC circuit breaker panel.

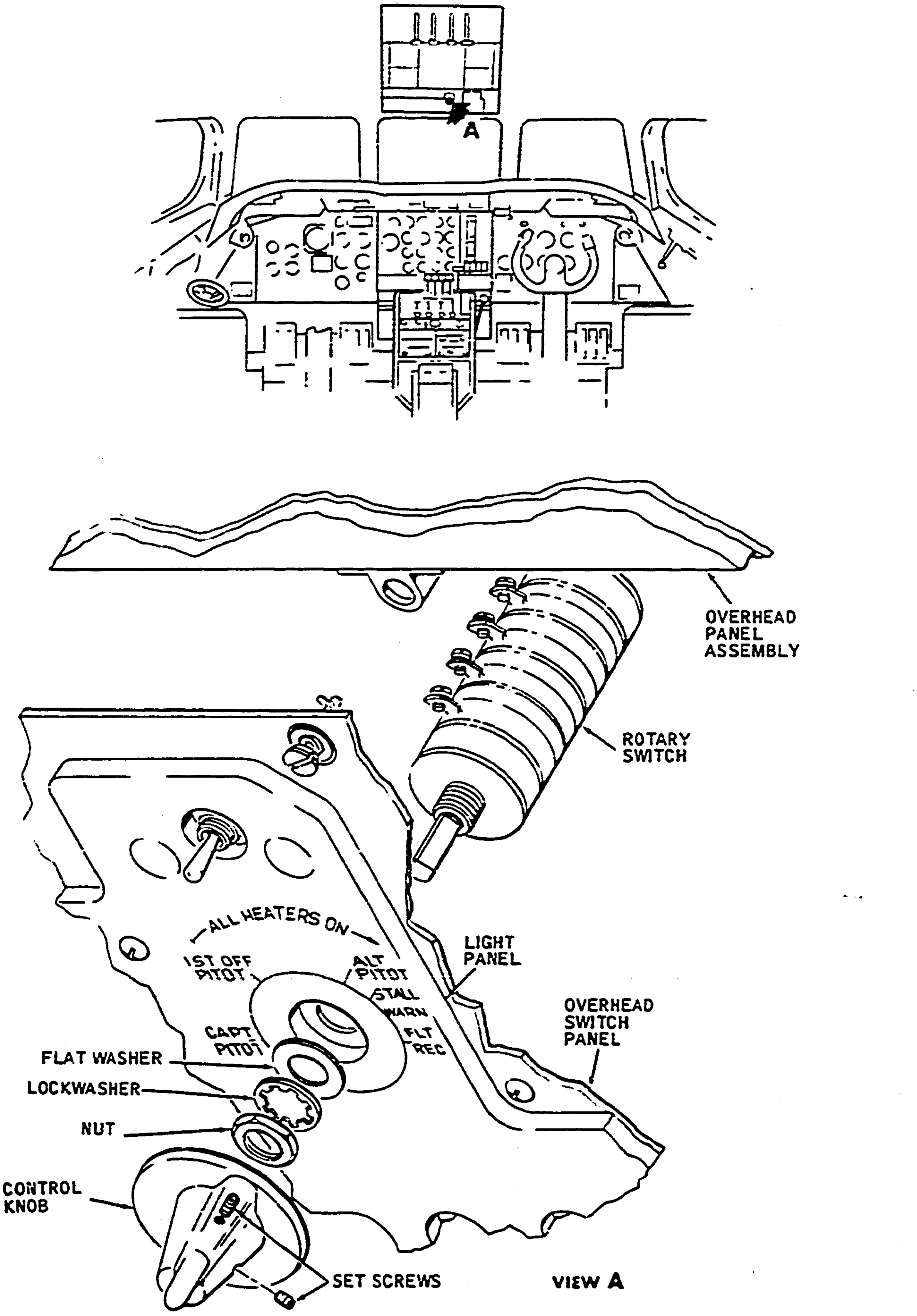
Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous (ac bus)
Flight recorder pitot heater	Right ac emergency bus

      WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 13).

      (2) Remove overhead switch panel (see Chapter 31).

      (3) Disconnect and tag wires at rear of switch.

      (4) Remove switch.



Anti-Icing Heaters and Ammeter Selector
Switch -- Installation
Figure 201

B. Install Selector Switch

(1) Make certain that following circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Flight recorder pitot heater	Right ac emergency bus

(2) Install switch on overhead switch panel.

(3) Remove tags and connect wires to switch.

(4) Install overhead switch panel (see Chapter 31).

(5) Close following circuit breakers.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergenby bus
Stall warning control and heater	Miscellaneous ac bus
Flight recorder pitot heater	Right ac emergency bus

3. Adjustment/Test Anti-Icing Heaters and Ammeter Selector Switch

A. To test heaters and ammeter selector switch, perform pitot and static system test (see 30-30-0, Maintenance Practices).

ANTI-ICING HEATERS AND AMMETER SELECTOR SWITCH - MAINTENANCE PRACTICES

1. General

   A. The anti-icing heaters and ammeter selector switch is located in the flight compartment on the overhead switch panel, adjacent to the ammeter.

2. Removal/Installation Anti-Icing Heaters and Ammeter Selector Switch

   A. Remove Selector Switch

      (1) Open following circuit breakers located on EPC circuit breaker panel.

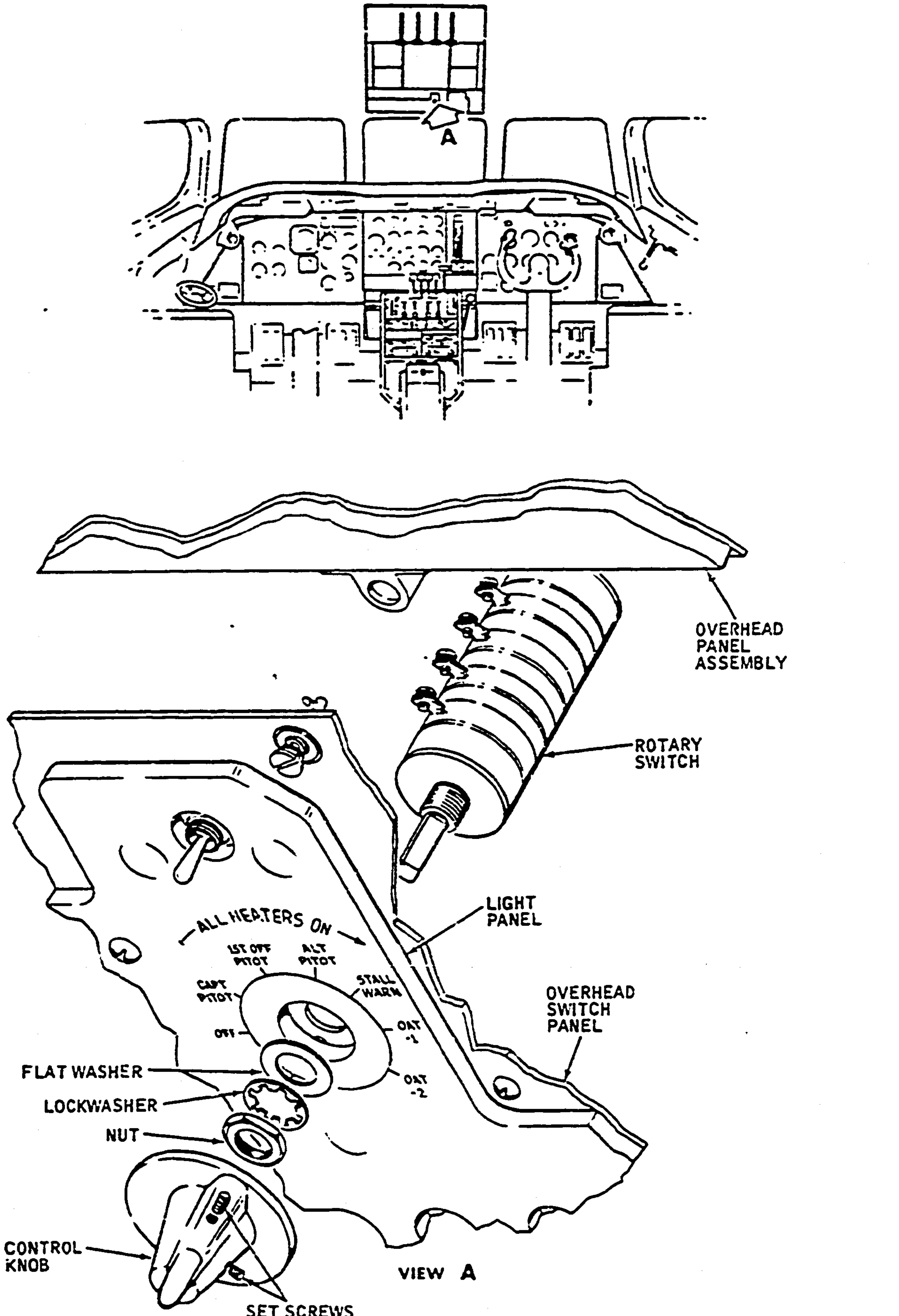
Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning	Miscellaneous ac bus
Outside air temperature right	Right ac emergency bus
Outside air temperature left	Right ac emergency bus

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 13).

      (2) Remove overhead switch panel (see Chapter 31).

      (3) Disconnect and tag wires at rear of switch.

      (4) Remove switch.



Anti-Icing Heaters and Ammeter Selector
Switch -- Installation
Figure 201

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B. Install Selector Switch

(1) Make certain that following circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning	Miscellaneous ac bus
Outside air temperature right	Right ac emergency bus
Outside air temperature left	Right ac emergency bus

(2) Install switch on overhead switch panel.

(3) Remove tags and connect wires to switch.

(4) Install overhead switch panel (see Chapter 31).

(5) Close following circuit breakers.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning	Miscellaneous ac bus
Outside air temperature right	Right ac emergency bus
Outside air temperature left	Right ac emergency bus

3. Adjustment/Test Anti-Icing Heaters and Ammeter Selector Switch

A. To test heaters and ammeter selector switch, perform pitot and static system test (see 30-30-0, Maintenance Practices).

ANTI-ICING HEATER AMMETER - MAINTENANCE PRACTICES

1. General

   A. The anti-icing heater ammeter is located in the flight compartment on the overhead switch panel adjacent to the anti-icing heaters and ammeter selector switch.

2. Removal/Installation Anti-Icing Heater Ammeter

   A. Remove Ammeter

      (1) Open following circuit breakers located on EPC circuit breaker panel.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 13).

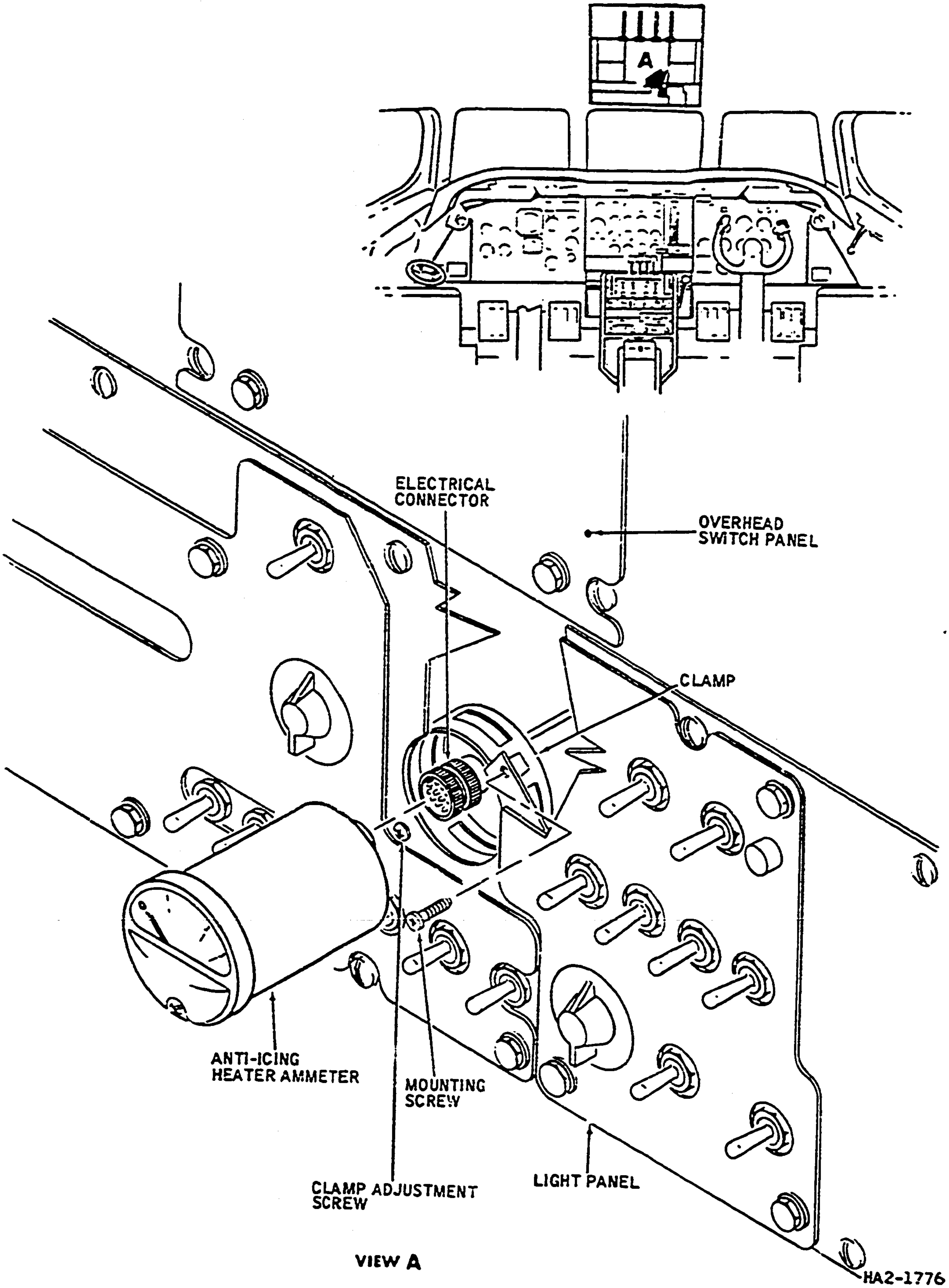
      (2) Loosen screw at upper right side of anti-icing heater ammeter.

      (3) Remove ammeter from switch panel. Disconnect and cap electrical connector from ammeter.

   B. Install Ammeter

      (1) Make certain that following circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus



Anti-Icing Heater Ammeter -- Installation
Figure 201

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(2) Connect electrical connector to ammeter and position ammeter in overhead switch panel.

(3) Tighten screw on switch panel.

(4) Close following circuit breakers.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus

3. Adjustment/Test Anti-Icing Heater Ammeter

A. To test heater ammeter, perform pitot and static system test (see 30-30-0, Maintenance Practices).

ANTI-ICING HEATER AMMETER - MAINTENANCE PRACTICES

1. General

   A. The anti-icing heater ammeter is located in the flight compartment on the overhead switch panel adjacent to the anti-icing heaters and ammeter selector switch.

2. Removal/Installation Anti-Icing Heater Ammeter

   A. Remove Ammeter

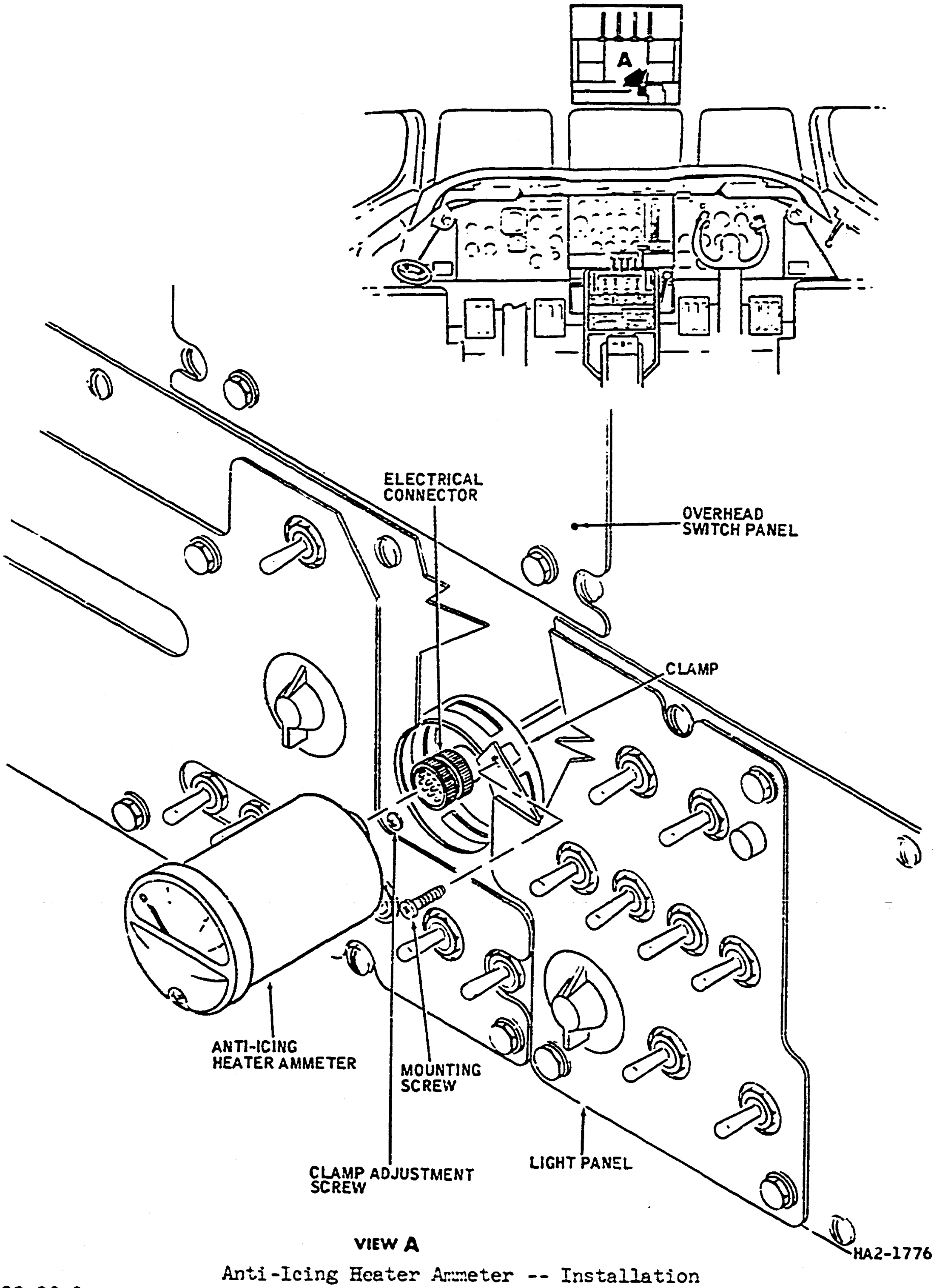
      (1) Open following circuit breakers located on EPC circuit breaker panel.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Speed command attitude transducer heaters (right and left)	Heat, vent, and ice protection ac bus
Flight recorder and temperature probe pitot heater	Right ac emergency bus

      WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 13).

      (2) Loosen screw at upper right side of anti-icing heater ammeter.

      (3) Remove ammeter from switch panel. Disconnect and cap electrical connector from ammeter.



Anti-Icing Heater Ammeter -- Installation
Figure 201

B. Install Ammeter

(1) Make certain that following circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Speed command attitude transducer heaters (right and left)	Heat, vent, and ice protection ac bus
Flight recorder and temperature probe pitot heater	Right ac emergency bus

(2) Connect electrical connector to ammeter and position ammeter in overhead switch panel.

(3) Tighten screw on switch panel.

(4) Close following circuit breakers.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Speed command attitude transducer heaters (right and left)	Heat, vent, and ice protection ac bus
Flight recorder and temperature probe pitot heater	Right ac emergency bus

3. Adjustment/Test Anti-Icing Heater Ammeter

A. To test heater ammeter, perform pitot and static system test (see 30-30-0, Maintenance Practices).

ANTI-ICING HEATER AMMETER - MAINTENANCE PRACTICES

1. General

   A. The anti-icing heater ammeter is located in the flight compartment on the overhead switch panel adjacent to the anti-icing heaters and ammeter selector switch.

2. Removal/Installation Anti-Icing Heater Ammeter

   A. Remove Ammeter

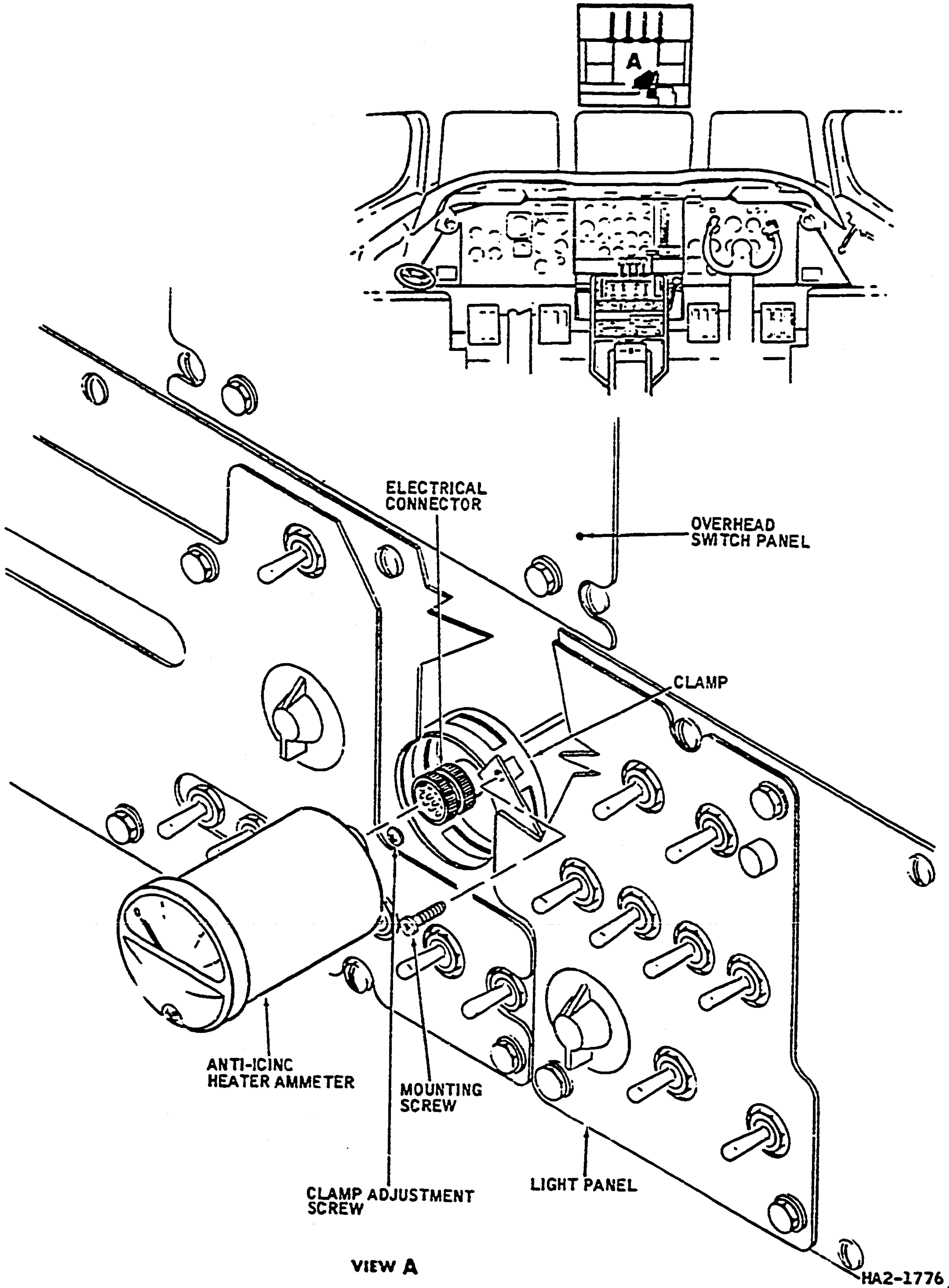
      (1) Open following circuit breakers located on EPC circuit breaker panel.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Flight recorder pitot heater	Right ac emergency bus
Ram air temperature	Heat vent and ice protection ac bus

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 13).

      (2) Loosen screw at upper right side of anti-icing heater ammeter.

      (3) Remove ammeter from switch panel. Disconnect and cap electrical connector from ammeter.



Anti-Icing Heater Ammeter -- Installation
Figure 201

B. Install Ammeter

(1) Make certain that following circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Flight recorder pitot heater	Right ac emergency bus
Ram air temperature	Heat vent and ice protection ac bus

(2) Connect electrical connector to ammeter and position ammeter in overhead switch panel.

(3) Tighten screw on switch panel.

(4) Close following circuit breakers.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Flight recorder pitot heater	Right ac emergency bus
Ram air temperature	Heat vent and ice protection ac bus

3. Adjustment/Test Anti-Icing Heater Ammeter

A. To test heater ammeter, perform pitot and static system test (see 30-30-0, Maintenance Practices).

ANTI-ICING HEATER AMMETER - MAINTENANCE PRACTICES

1. General

   A. The anti-icing heater ammeter is located in the flight compartment on the overhead switch panel, adjacent to the anti-icing heaters and ammeter selector switch.

2. Removal/Installation Anti-Icing Heater Ammeter

   A. Remove Ammeter

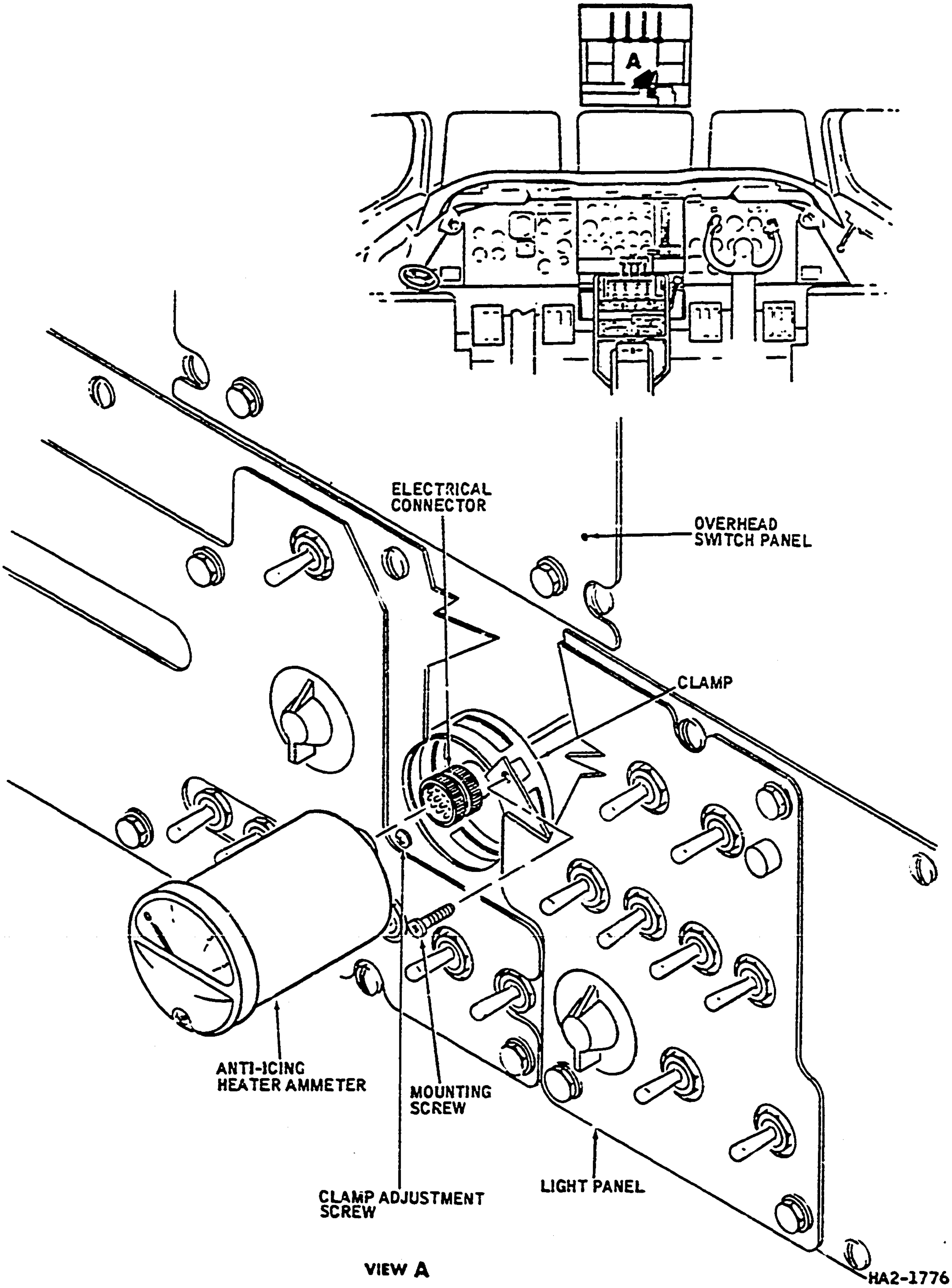
      (1) Open following circuit breakers located on EPC circuit breaker panel.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Flight recorder pitot heater	Right ac emergency bus

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 13).

      (2) Loosen screw at upper right side of anti-icing heater ammeter.

      (3) Remove ammeter from switch panel. Disconnect and cap electrical connector from ammeter.



VIEW A

Anti-Icing Heater Ammeter -- Installation
Figure 201

B. Install Ammeter

(1) Make certain that following circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Flight recorder pitot heater	Right ac emergency bus

(2) Connect electrical connector to ammeter and position ammeter in overhead switch panel.

(3) Tighten screw on switch panel.

(4) Close following circuit breakers.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning control and heater	Miscellaneous ac bus
Flight recorder pitot	Right ac emergency bus

3. <u>Adjustment/Test Anti-Icing Heater Ammeter</u>

A. To test heater ammeter, perform pitot and static system test (see 30-30-0, Maintenance Practices).

ANTI-ICING HEATER AMMETER - MAINTENANCE PRACTICES

1. General

A. The anti-icing heater ammeter is located in the flight compartment on the overhead switch panel adjacent to the anti-icing heaters and ammeter selector switch.

2. Removal/Installation Anti-Icing Heater Ammeter

A. Remove Ammeter

(1) Open following circuit breakers located on EPC circuit breaker panel.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning	Miscellaneous ac bus
Outside air temperature right	Right ac emergency bus
Outside air temperature left	Right ac emergency bus

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 13).

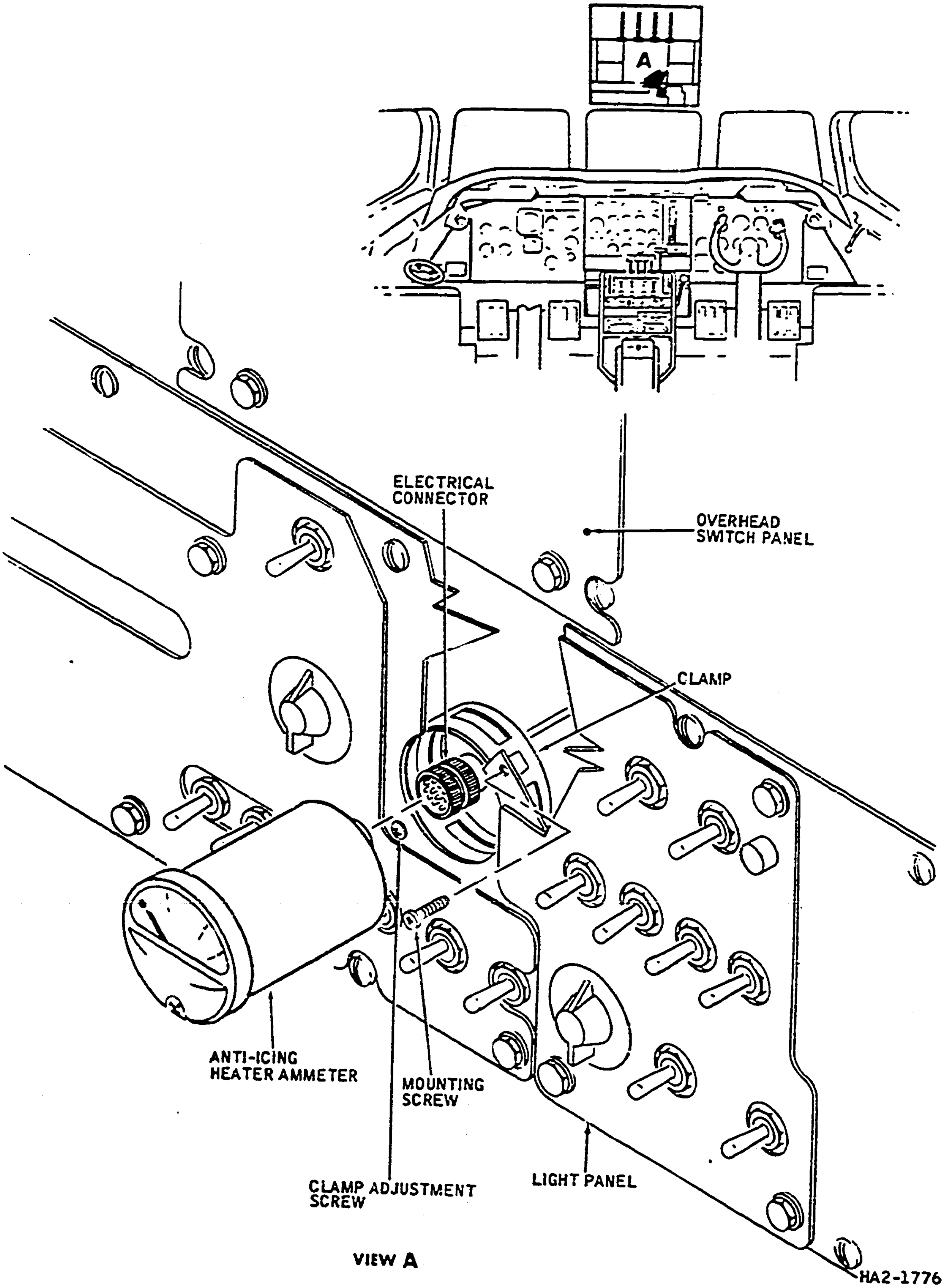
(2) Loosen screw at upper right side of anti-icing heater ammeter.

(3) Remove ammeter from switch panel. Disconnect and cap electrical connector from ammeter.

B. Install Ammeter

(1) Make certain that following circuit breakers located on EPC circuit breaker panel are open.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus



Anit-Icing Heater Ammeter -- Installation
Figure 201

Circuit Breaker	Panel Section
Alternate pitot heater	Left ac emergency bus
Stall warning	Miscellaneous ac bus
Outside air temperature right	Right ac emergency bus
Outside air temperature left	Right ac emergency bus

(2) Connect electrical connector to ammeter and position ammeter in overhead switch panel.

(3) Tighten screw on switch panel.

(4) Close following circuit breakers.

Circuit Breaker	Panel Section
Captain's pitot heater	Left ac emergency bus
First officer's pitot heater	Right ac emergency bus
Alternate pitot heater	Left ac emergency bus
Stall warning	Miscellaneous ac bus
Outside air temperature right	Right ac emergency bus
Outside air temperature left	Right ac emergency bus

3. Adjustment/Test Anti-Icing Heater Ammeter

A. To test heater ammeter, perform pitot and static system test (see 30-30-0, Maintenance Practices).

WINDOWS AND WINDSHIELDS - DESCRIPTION AND OPERATION

1. General

A. Each windshield outer panel assembly (one for the left, center, and right windshields) is heated by an electric current which passes through a conductive oxide coating. This coating is fused to the aft face of the outer glass ply of each panel assembly. The heating effect provides elasticity enabling the assembly to withstand impact from flying objects and anti-ices and defogs the assembly for clear vision. A similar conductive coating is incorporated in the two eyebrows and in the two clearview window inner surfaces of the outer ply. The heating effect provides for impact resistance and defogging.

B. The windshield and window heat control system consists of the following components:

(1) Temperature-sensing elements sealed in the vinyl interlayer of the panel assemblies for each windshield and window

(2) Amplifiers, one for each windshield and window, located on the forward equipment panel of the electrical power center

(3) Control relays, two for each windshield, and autotransformers, one for each windshield, located on the forward equipment panel next to the amplifiers

(4) A windshield heat control switch, located on the overhead switch panel with off, warm up, and full power positions

NOTE: The windshield heat control switch is a lever-lock type and must be pulled out before it can be moved to the full power position.

(5) Heating elements (conductive coatings), one for each windshield and window.

C. The windshield heat switch controls both the windshield and the window panel circuits. The resistance of the sensing elements is effected by the panel temperature and forms the variable leg of the amplifier bridge circuitry. A sufficient change in the resistance causes the amplifier to apply load current to, or remove load current from, the panels as the temperature requires. A fail-safe circuit in each amplifier disconnects the load circuit from the panel in the event that a sensing element becomes shorted. The windshield load switching is accomplished by relays in each amplifier and by control relays and autotransformers outside the amplifiers. Bleed resistors are connected to the control relays to prevent the possibility of voltage breakdown and arcing at the windshield terminals, caused by static buildup when the window heating element is isolated from ground. The window load circuits are switched directly by the amplifier relays without the use of control relays or autotransformers.

When called for by the amplifier, the autotransformers apply a low or high voltage depending on whether the switch is in the warm up or the full power position.

D. A windshield pneumatic rain removal system is provided for the left and right windshields. Bleed air from the pneumatic system is ducted through the pneumatic manifold to the rain removal shutoff valves and is controlled by levers in the flight compartment. When opened, the valves allow an air blast to pass through plenum chambers, which direct the air onto the windshields, causing water to form into beads and roll off the glass.

WINDOWS AND WINDSHIELD - DESCRIPTION AND OPERATION

1. General

A. The windshield panels (left, center, and right), the two eyebrow windows and the two clearview windows are electrically heated by elements (conductive coatings) in the glass. The heated glass provides a shock-resistance surface for flying objects. The windshields are heated on both inner and outer surfaces which also provides anti-icing and antifogging of the glass. The four windows are heated on the inner surfaces only.

B. Temperatures of the outer surfaces of the windshield panels are sensed by sensing elements which work in conjunction with the temperature controllers to regulate current flow to the heating elements.

C. The inner (anti-fogging elements) are controlled by thermal switches on the glass which make or break the electrical circuits to the heating elements, thereby controlling the temperature. The anti-fogging system is used during certain weather contitions on the ground to clear the windhsields and windows and shorten dispatch time, and in the air to prevent fogging of the glass during rapid ascent or descent.

D. A pneumatic and a liquid rain repellent system are provided for the left and right windshields. The pneumatic rain removal system operates from the pneumatic system and is controlled by levers in the flight compartment and may be operated either indepencently, or in conjunction with, the rain repellent system.

E. The rain repellent system is controlled by a switch in the flight compartment. When the switch is depressed, rain repellent fluid is sprayed on the surfaces of the left and right windshields from spray nozzles near the lower edge of the windshields. The fluid when spread by pneumatic source or the slipstream, causes water to form into beads and roll off the glass.

F. A windshield pneumatic rain removal system is provided for the left and right windshields. Bleed air from the pneumatic system is ducted through the pneumatic manifold to the rain removal shutoff valves and is controlled by levers in the flight compartment. When opened, the valves allow an air blast to pass through plenum chambers, which direct the air onto the windshields, causing water to form into beads and roll off the glass.

WINDOWS AND WINDSHIELD ANTI-ICING/ANTI-FOGGING - DESCRIPTION AND OPERATION

1. Description

A. Each windshield outer panel assembly (one for the left, center, and right windshields) is heated by an electric current which passes through a conductive oxide coating. This coating is fused to the aft face of the outer glass ply of each panel assembly. The heating effect is two-fold: (1) Provides elasticity enabling the assembly to withstand impact from flying objects, and (2) Anti-ices and defogs the assembly for clear vision. A similar conductive coating is incorporated in the two eyebrow and in the two clearview window inner surfaces of the outer ply. The heating effects provide for impact resistance and defogging.

B. The windshield and window heat control system consists of the following components:

(1) Temperature-sensing elements sealed in the vinyl interlayer of the panel assemblies for each windshield and window;

(2) Amplifiers, one for each windshield and window, located on the forward equipment panel of the electrical power center;

(3) Control relays, two for each windshield, and autotransformers, one for each windshield, located on the forward equipment panel next to the amplifiers.

(4) A windshield heat control switch, located on the overhead switch panel with OFF, WARM UP, and FULL POWER positions;

NOTE: The windshield heat control switch is a leverlock type and must be pulled out before it can be moved to the FULL POWER position.

(5) Heating elements (conductive coatings), one for each windshield and window.

2. Operation

A. The windshield heat switch controls both the windshield and the window panel circuits. The resistance of the sensing elements is affected by the panel temperature and forms the variable leg of the amplifier bridge circuitry. A sufficient change in the resistance causes the amplifier to apply load current to, or remove load current from, the panels as the temperature requires. A fail-safe circuit in each amplifier disconnects the load circuit from the panel in the event that a sensing element becomes shorted. The windshield load switching is accomplished by relays in each amplifier and by control relays and autotransformers outside the amplifiers. Bleed resistors are connected to the control relays to prevent the possibility of voltage breakdown and arcing at the windshield terminals

caused by static buildup when the window heating element is isolated from ground. The window load circuits are switched directly by the amplifier relays without the use of control relays or autotransformers.

B. When called for by the amplifier, the autotransformers apply a low or high voltage depending on whether the switch is in the WARM UP or the FULL POWER position.

WINDOWS AND WINDSHIELD ANTI-ICING/ANTI-FOGGING - DESCRIPTION AND OPERATION

1. General

A. Each windshield panel (left, center, and right) is electrically heated by two elements installed in the glass. One element (conductive coating) is fused to the aft face of the outer glass ply and the other is fused to the forward face of the inner glass ply of each panel. The heating effect of both elements provides elasticity enabling the panel to withstand impact force from flying objects. Electrical heating provides anti-icing of the external surface (see Figure 1) and antifogging on the internal surface of the glass (see Figure 2). An element (conductive coating) is also fused to the forward face of the inner glass ply of the two eyebrow windows and two clearview windows to provide antifogging of the internal surfaces.

B. The window and windshield heating system consists of the following components:

(1) Two temperature sensing elements for windshield anti-icing, sealed in the inner ply of each windshield panel (one in use; the other for standby).

(2) Heating elements (conductive coatings), one in each window and two in each windshield panel.

(3) Thermal switches, one in inside surface of each clearview and eyebrow window, and windshield panel.

(4) Temperature controllers, one for each windshield, located in the electrical power center forward equipment panel.

(5) Transformers, one for each windshield anti-ice electrical system, located in the electrical power center forward panel.

(6) Windshield heater switch located on the forward overhead switch panel.

(7) Antifog relay, one for all heated glass panels, located on the electrical power center forward equipment panel.

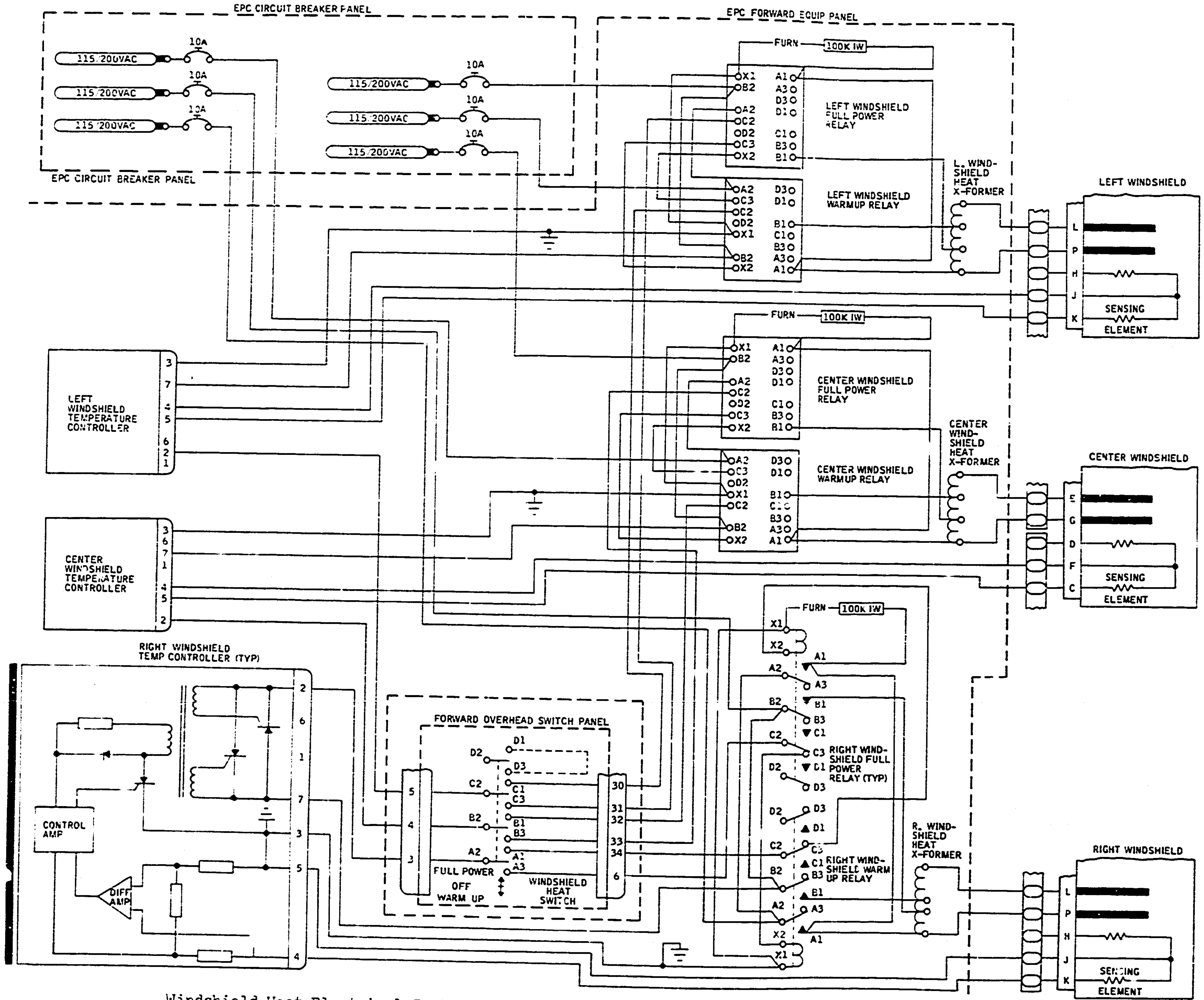
(8) Windshield temperature control relays, two for each windshield, located in the EPC forward equipment panel.

C. The windshield temperature controller is a solid state electronic device that controls the temperature of the glass panels by switching electrical power on and off as required. Input electrical power to each controller is 115 vac. The output of each controller is routed through a step up transformer where the voltage is stepped-up to supply approximately 254 vac to the windshield heating element with the control switch in warm-up or approximately 350 vac with the control switch in full power position.

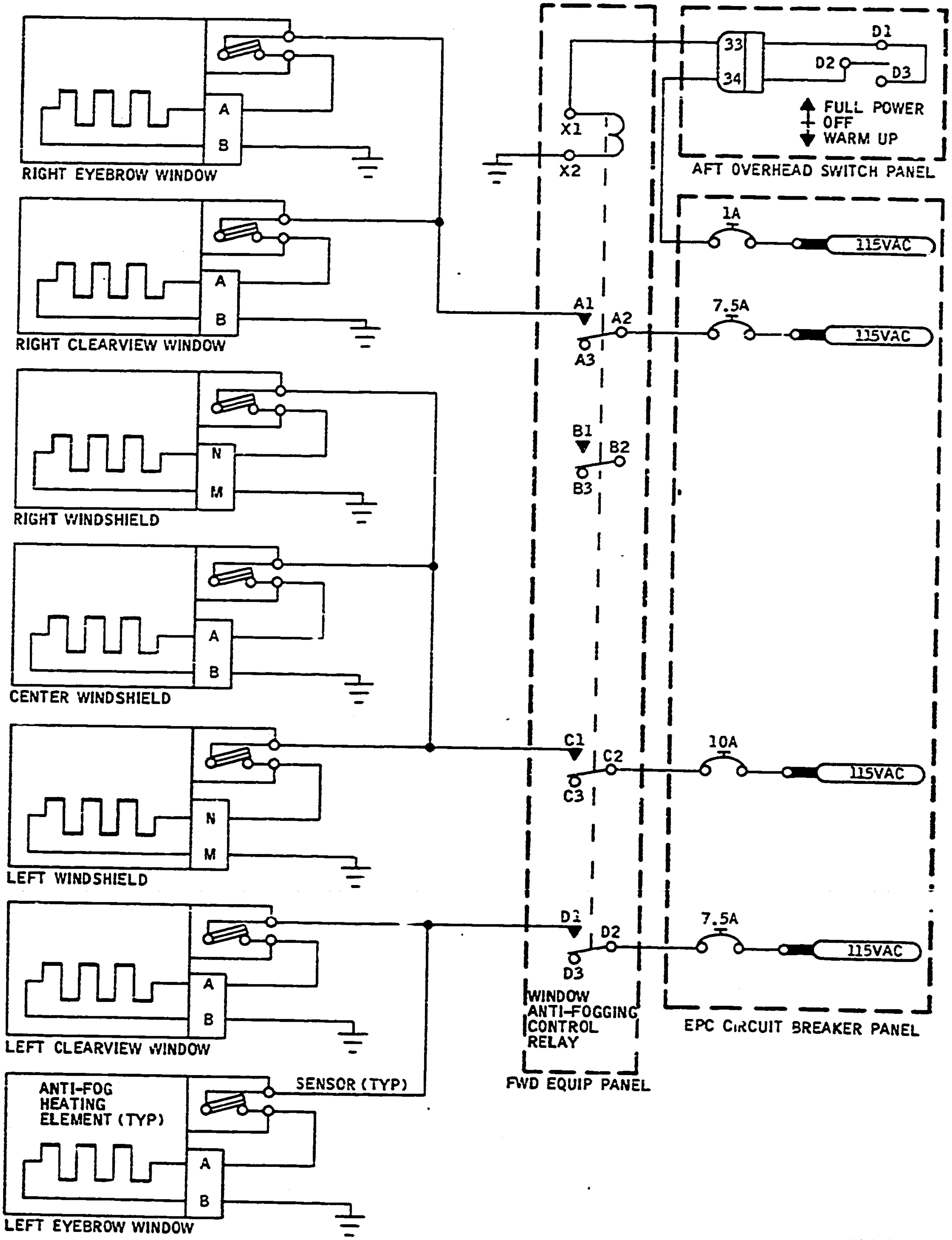
2. Operation

A. Temperature control of each windshield panel for shock-proofing and anti-icing is accomplished by sensing elements installed in the glass working in conjunction with a temperature controller. The elements, affected by the temperature of the glass, signal the controller to switch on or off the electrical power to the heating elements in the glass.

B. The antifog heating system is not normally used, as heating of the inner surfaces of the glass is required only under certain weather conditions. The windshield ice protection switch controls both the windshield heat and antifogging electrical circuits, however the cockpit window antifog control circuit breakers are normally left open to permit operation of windshield heat without turning on the antifogging system. When the windshield ice protection switch is turned on, and the antifog circuit breakers are closed, the windshield defog control relay is energized to close the circuits to the antifogging heating elements. The anti-ice circuits are closed directly by the switch. As temperatures of the inner glass panel of each windshield and window change, the thermal switches mounted against the glass make or break the circuitry to the antifogging heater elements to control temperature.



Windshield Heat Electrical System -- Schematic
Figure 1



Window and Windshield Antifogging System -- Schematic
Figure 2

WINDOWS AND WINDSHIELD ANTI-ICING/ANTI-FOGGING - DESCRIPTION AND OPERATION

1. General

A. Each windshield panel (left, center, and right) is electrically heated by two elements installed in the glass. One element (conductive coating) is fused to the aft face of the outer glass ply and the other is fused to the forward face of the inner glass ply of each panel. The heating effect of both elements provides elasticity enabling the panel to withstand impact force from flying objects. Electrical heating provides anti-icing of the external surface (see Figure 1) and antifogging on the internal surface of the glass (see Figure 2). An element (conductive coating) is also fused to the forward face of the inner glass ply of the two eyebrow windows and two clearview windows to provide antifogging of the internal surfaces.

B. The windshield heating elements are protected by an abnormal temperature detector. If the temperature of the windshield glass is above or below normal, the detector energizes caution lights on the systems engineer's instrument panel.

C. The window and windshield heating system consists of the following components:

(1) Two temperature sensing elements for windshield anti-icing, sealed in the inner ply of each windshield panel (one for heat control; the other for the over/under temperature detector).

(2) Heating elements (conductive coatings), one in each window and two in each windshield panel.

(3) Thermal switches, one in inside surface of each clearview and eyebrow window, and windshield panel.

(4) Temperature controllers, one for each windshield, located in the electrical power center forward equipment panel.

(5) Transformers, one for each windshield anti-ice electrical system, located in the electrical power center forward panel.

(6) Windshield heater switch located on the forward overhead switch panel.

(7) Antifog relay, one for all heated glass panels, located on the electrical power center forward equipment panel.

(8) Windshield over/under temperature detector, one for the three windshields, located on the electrical power center forward panel.

(8) Windshield temperature control relays, two for each windshield, located in the EPC forward equipment panel.

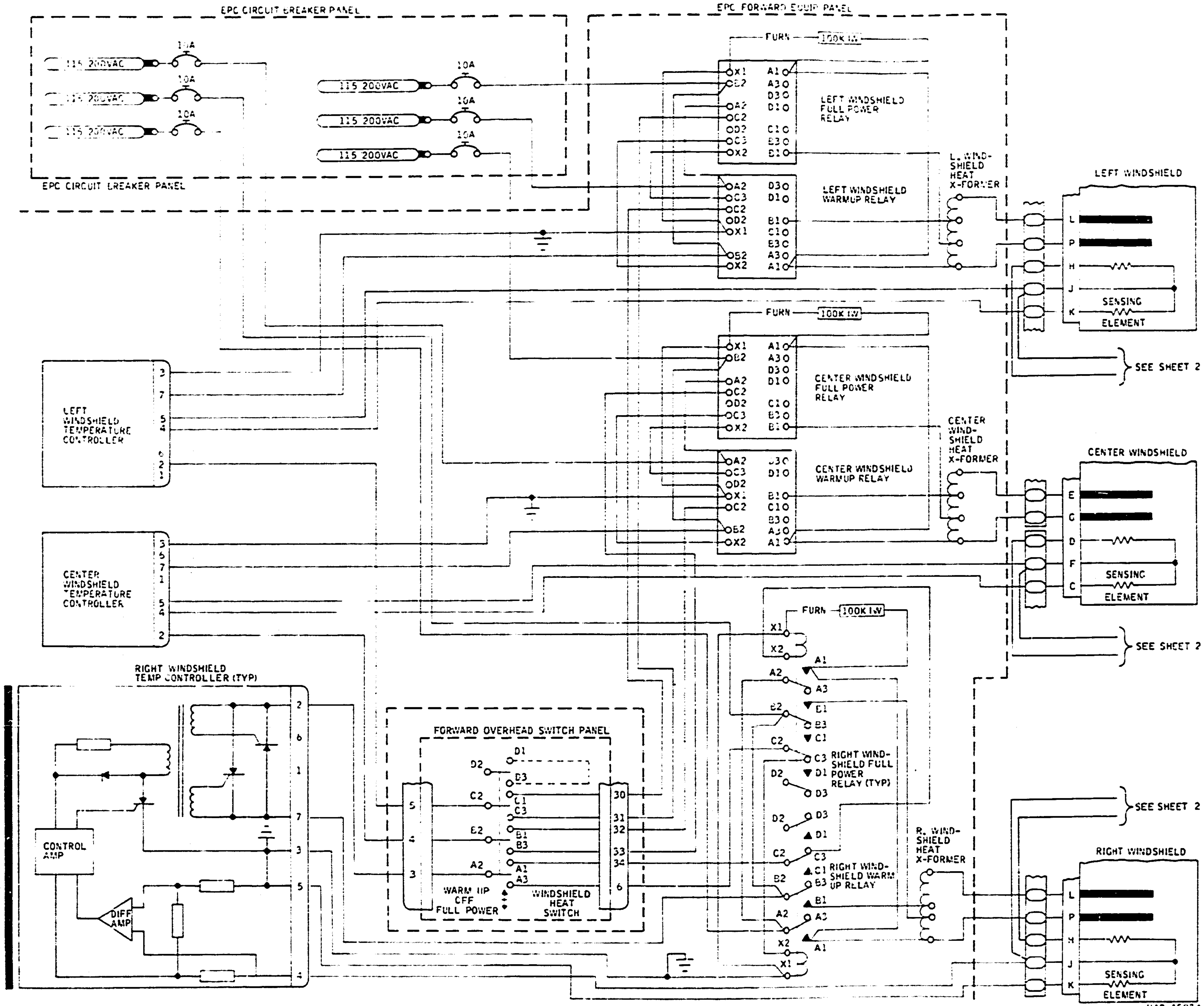
D. The windshield temperature controller is a solid state electronic device that controls the temperature of the glass panels by switching electrical power on and off as required. Input electrical power to each controller is 115 vac. The output of each controller is routed through a step up transformer where the voltage is stepped-up to supply approximately 254 vac to the windshield heating element with the control switch in warm-up or approximately 350 vac with the control switch in full power position.

2. Operation

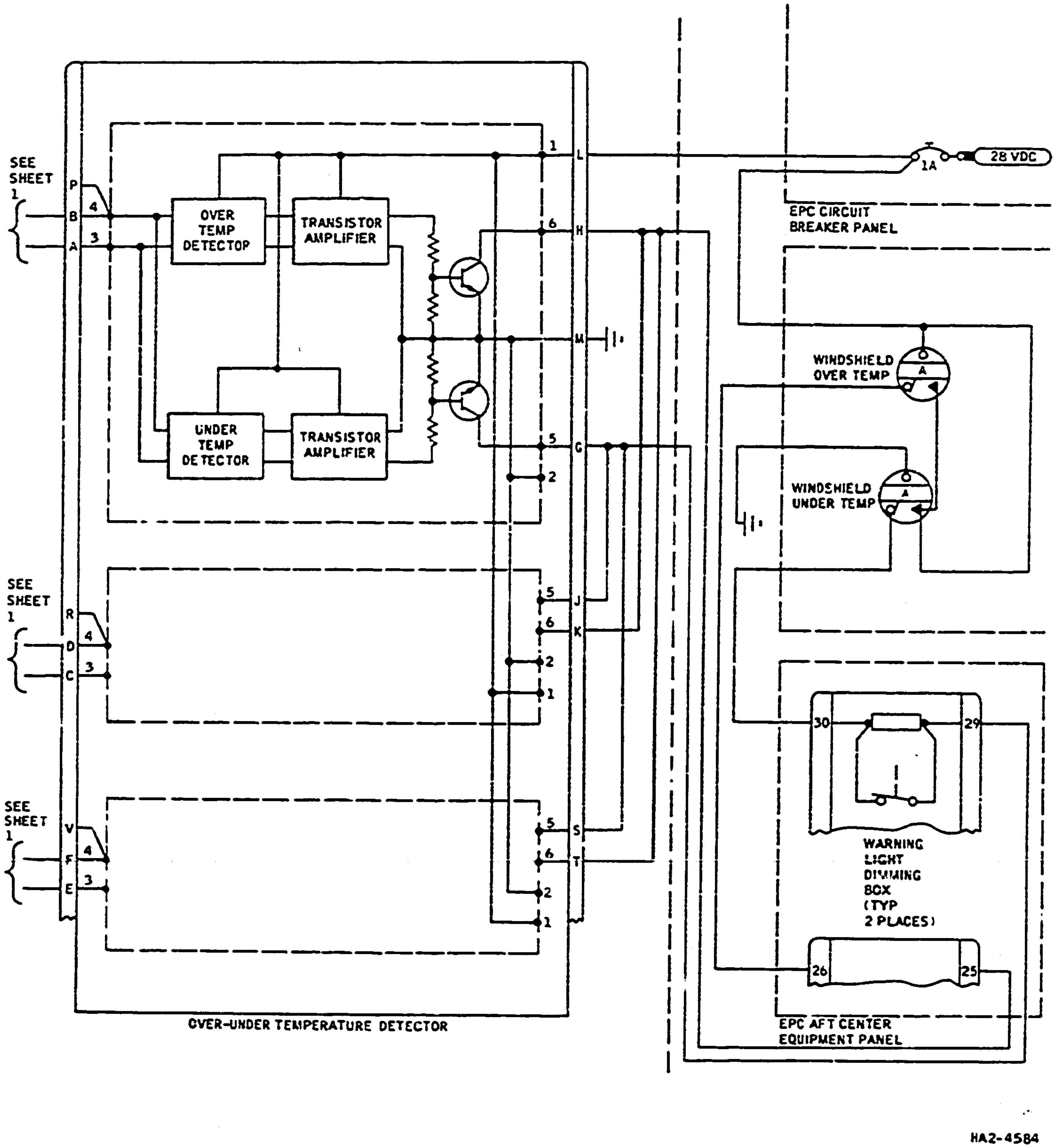
A. Temperature control of each windshield panel for shock-proofing and anti-icing is accomplished by sensing elements installed in the glass working in conjunction with a temperature controller. The elements, affected by the temperature of the glass, signal the controller to switch on or off the electrical power to the heating elements in the glass.

B. Indication of over/under temperature of the windshield glass panels is provided by the over/under temperature detector. A second sensor, installed in each windshield glass, provides an under or over temperature signal to the detector. When the temperature is low the windshield under temperature light on the system engineers panel is activated, when the temperature is high the windshield overtemperature light is activated.

C. The antifog heating system is not normally used, as heating of the inner surfaces of the glass is required only under certain weather conditions. The windshield ice protection switch controls both the windshield heat and antifogging electrical circuits, however the cockpit window antifog control circuit breakers are normally left open to permit operation of windshield heat without turning on the antifogging system. When the windshield ice protection switch is turned on, and the antifog circuit breakers are closed, the windshield defog control relay is energized to close the circuits to the antifogging heating elements. The anti-ice circuits are closed directly by the switch. As temperatures of the inner glass panel of each windshield and window change, the thermal switches mounted against the glass make or break the circuitry to the antifogging heater elements to control temperature.

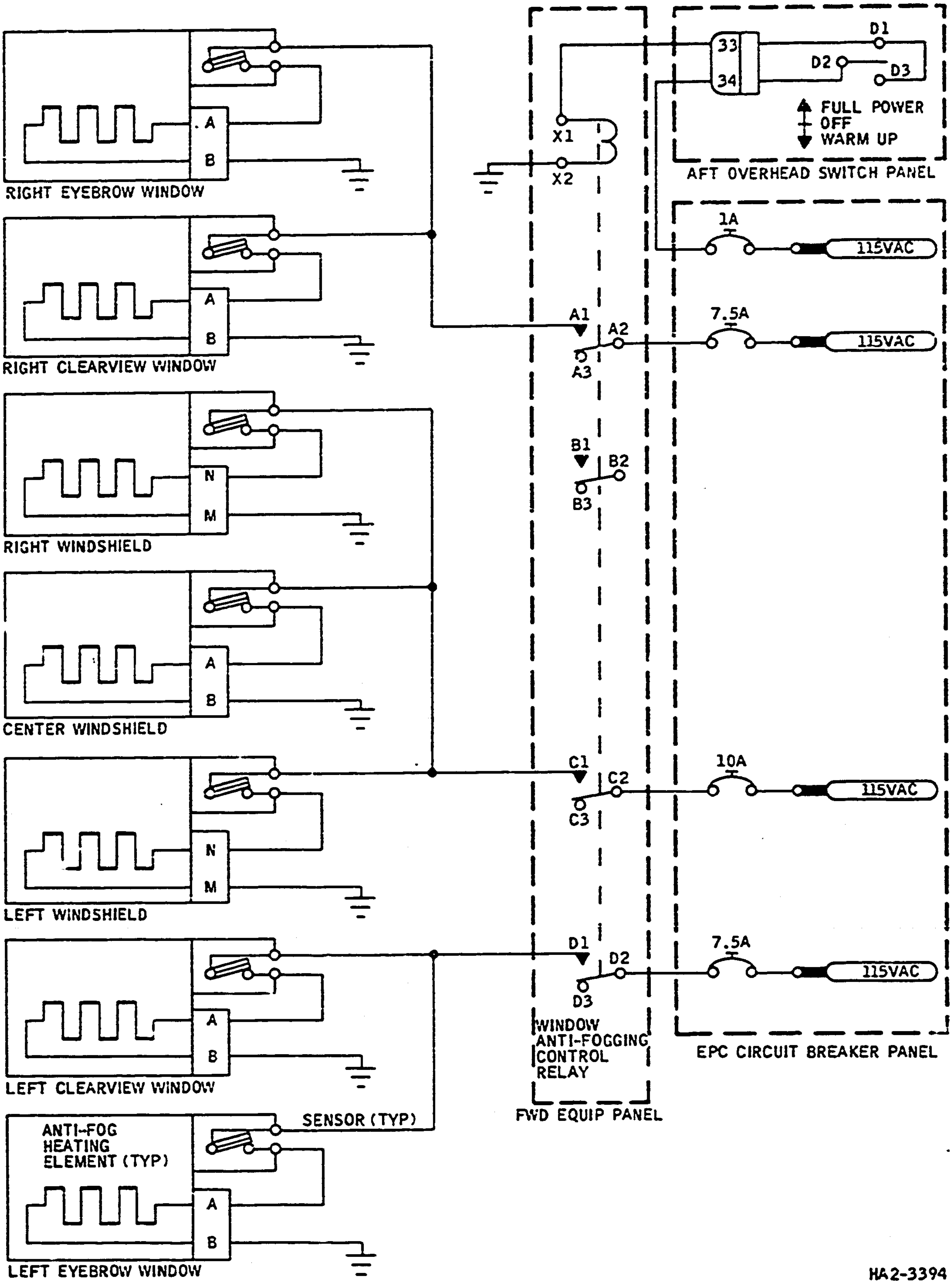


Windshield Heat Electrical System -- Schematic
Figure 1 (Sheet 1)



Windshield Heat Electrical System -- Schematic
Figure 1 (Sheet 2)

Printed in U.S.A.



Window and Windshield Antifogging System -- Schematic
Figure 2

Printed in U.S.A.

WINDOWS AND WINDSHIELD ANTI-ICING/ANTIFOGGING - TROUBLE SHOOTING

1. General

A. The trouble shooting procedures for the windshields (right, center, and left) are identical. Figure 101 reflects the right windshield heat control circuit. Refer to the Electrical Wiring Diagram Manual for the center and left windshield heat control circuits.

B. The trouble shooting procedures for the left and right eyebrow and clear-view windows are identical. Figure 102 reflects the window heat control circuit.

C. Windshield line checkers (see Paragraph 2) can be used to trouble shoot the windshield amplifier (controller) and circuits by following the instructions which accompany the checker.

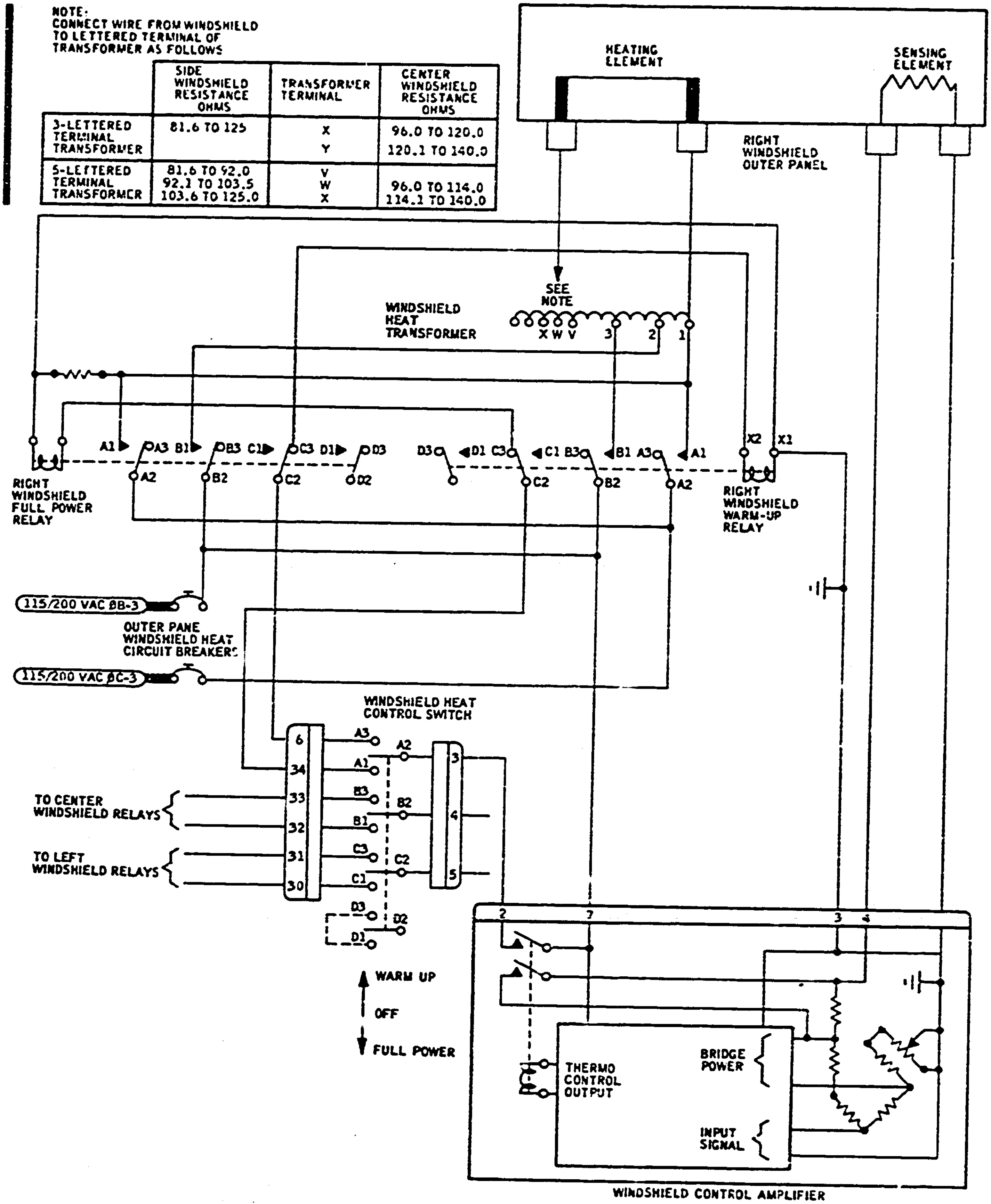
2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Multimeter	260	Simpson	Continuity and resistance checks
B	Windshield heater system line checker	4767459	Douglas Aircraft Co., Inc.	Trouble shoot amplifier, and sensing and power circuits without operating windshield
	or			
	Dynamic windshield temperature line checker	4889798	Douglas Aircraft Co., Inc.	Trouble shoot controller and windshield circuits with windshield operating

NOTE:
CONNECT WIRE FROM WINDSHIELD TO LETTERED TERMINAL OF TRANSFORMER AS FOLLOWS

	SIDE WINDSHIELD RESISTANCE OHMS	TRANSFORMER TERMINAL	CENTER WINDSHIELD RESISTANCE OHMS
3-LETTERED TERMINAL TRANSFORMER	81.6 TO 125	X Y	96.0 TO 120.0 120.1 TO 140.0
5-LETTERED TERMINAL TRANSFORMER	81.6 TO 92.0 92.1 TO 103.5 103.6 TO 125.0	V W X	96.0 TO 114.0 114.1 TO 140.0



Right Windshield Heat Control
Circuit -- Schematic
Figure 101

3. Trouble Shoot Windows and Windshields

Possible Causes	Isolation Procedure	Correction

A. WINDSHIELD HEATS WITH CONTROL SWITCH IN FULL POWER POSITION, BUT NOT IN WARM UP POSITION

WARNING: THE OUTPUT VOLTAGES OF THE WINDSHIELD TRANSFORMERS ARE FROM 260 to 420 VOLTS, WITH A CURRENT RATING THAT IS DANGEROUS TO LIFE.

NOTE: Trouble shooting procedures are performed with control switch in warm up position.

Possible Causes	Isolation Procedure	Correction
(1) Faulty windshield heat transformer	With voltmeter set in 500-vac range, check for voltage from terminal 1 to 3 of transformer. If no voltage, proceed to step (2).	If voltage is present, replace transformer.
(2) Faulty wiring between warming relay and transformer.	Check for voltage from terminal B1 of warning relay to terminal 1 of transformer.	If voltage is present, repair or replace wire between terminal B1 of warm up relay to terminal 3 of transformer.
	If no voltage is present, check for voltage from terminal B2 of warm up relay to ground. If voltage is present, proceed to step (3).	If no voltage is present, repair or replace wire between terminal B2 of warm up relay and terminal B2 of full power relay.
(3) Faulty warm up relay	Check for voltage from terminal X1 to X2 of full power relay. If no voltage is present, check for voltage from terminal X2 of warm up relay to ground. If no voltage is present, proceed to step (4).	If voltage is present, replace warm up relay.

Possible Causes	Isolation Procedure	Correction
A. WINDSHIELD HEATS WITH CONTROL SWITCH IN FULL POWER POSITION, BUT NOT IN WARM UP POSITION (Continued)		
(4) Faulty wiring between overhead switch panel plug and warm up relay	Remove overhead switch panel (see Chapter 31). Check continuity from pin of plug to terminal C2 of full power relay and from pin of plug to terminal X2 of warm up relay (see Wiring Diagram Manual). If continuity exists, proceed to step (5).	If no continuity, repair or replace applicable wire.
(5) Faulty wiring between control switch and overhead panel plug	Check continuity between plug and control switches as follows: Pin 6 to terminal A3 Pin 33 to terminal B3 Pin 31 to terminal C3. If continuity exists, proceed to step (6).	If no continuity, repair or replace wire.
(6) Faulty control switch	Check continuity between following switch terminals: A2 to A3 B2 to B3 C2 to C3.	If no continuity, replace control switch.

B. WINDSHIELD HEATS WITH CONTROL SWITCH IN WARMUP, BUT NOT IN FULL POWER POSITION

WARNING: THE OUTPUT VOLTAGES OF THE WINDSHIELD TRANSFORMERS ARE FROM 260 to 420 VOLTS, WITH A CURRENT RATING THAT IS DANGEROUS TO LIFE.

NOTE: Trouble shooting procedures are performed with control switch in full power position.

Possible Causes	Isolation Procedure	Correction
(1) Faulty windshield heat transformer	With voltmeter set in 500-vac range, check for voltage from terminal 1 to 2 of transformer. If no voltage, proceed to step (2).	If voltage is present, replace heat transformer.

Possible Causes	Isolation Procedure	Correction
B. WINDSHIELD HEATS WITH CONTROL SWITCH IN WARMUP, BUT NOT IN FULL POWER POSITION (Continued)		
(2) Faulty wiring between relay and transformer	Check for voltage from terminal B1 of full power relay to terminal 1 of transformer.	If voltage is present, repair or replace wire between terminal B1 of full power relay to terminal 2 of transformer.
	If no voltage is present, check for voltage from terminal X2 of full power relay to ground. If no voltage is present, proceed to step (3).	If voltage is present, repair or replace wire between terminal X1 of full power relay and terminal X1 of warm up relay.
(3) Faulty full power relay	Check for voltage from terminal X1 to X2 of full power relay.	If voltage is present, replace full power relay.
	If no voltage is present, check for voltage from terminal X2 of full power relay to ground. If no voltage is present, proceed to step (4).	If voltage is present, repair or replace applicable ground wire (see Wiring Diagram Manual).
(4) Faulty wiring between overhead switch panel plug and full power relay.	Remove overhead switch panel (see Chpater 31). Check continuity from pin of plug to terminal C2 of warm up relay and from pin of plug to terminal X2 of full power relay (see Wiring Diagram Manual). If continuity exists, proceed to step (5).	If no continuity, repair or replace applicable wire.

Possible Causes	Isolation Procedure	Correction
B. WINDSHIELD WITH CONTROL SWITCH IN WARM UP BUT NOT IN FULL POWER POSITION (Continued)		
(5) Faulty wiring between control switch and overhead switch panel plug	Check continuity between plug and control switch as follows: Pin 34 to terminal A1 Pin 32 to terminal B1 Pin 30 to terminal C1. If continuity exists, proceed to step (6).	If no continuity, repair or replace wire.
(6) Faulty control switch	Check continuity between following switch terminals: A1 to A2 B1 to B2 C1 to C2.	If no continuity, replace switch.

C. WINDSHIELD DOES NOT HEAT WITH CONTROL SWITCH IN EITHER WARM UP OR FULL POWER POSITIONS

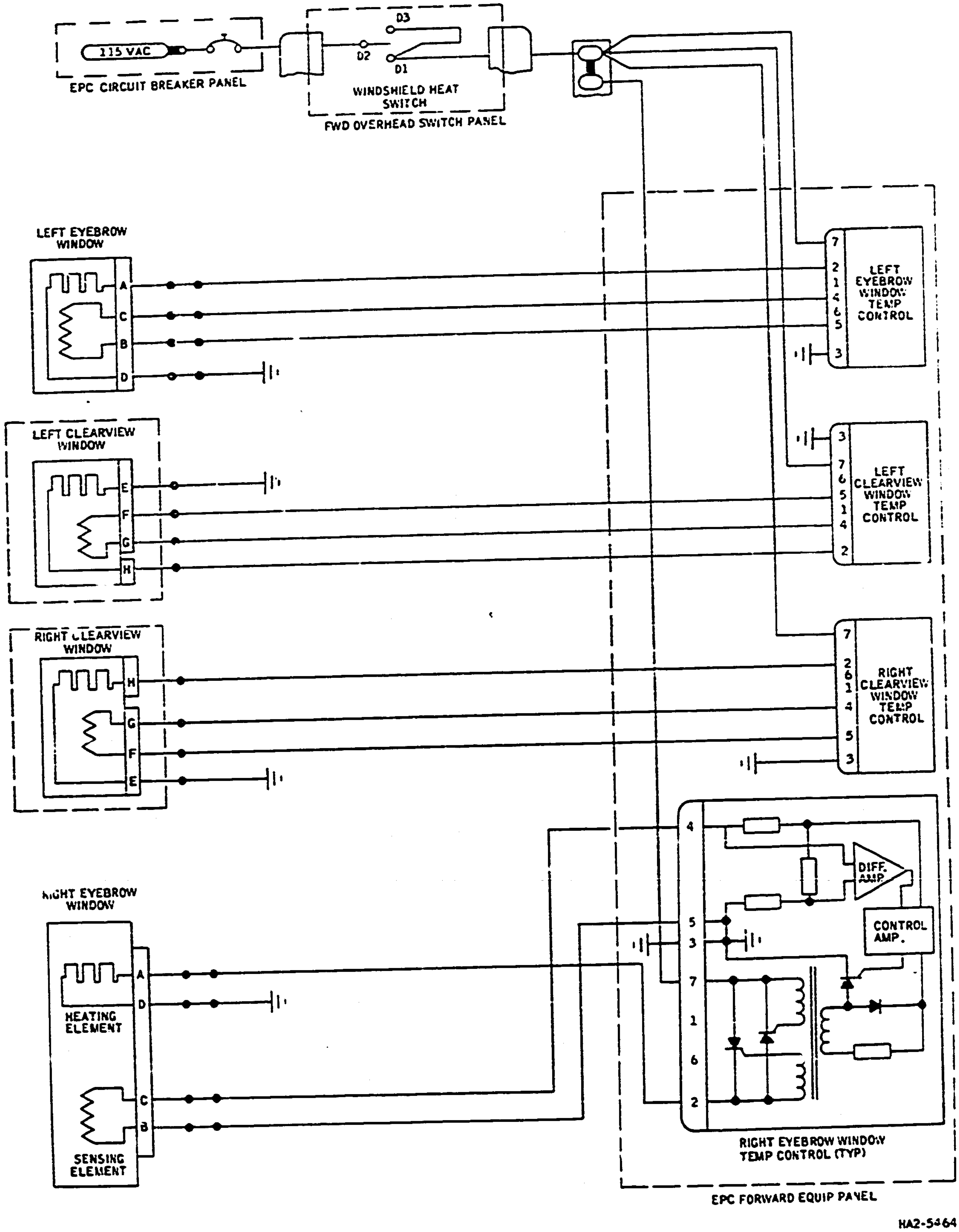
WARNING: THE OUTPUT VOLTAGES OF THE WINDSHIELD TRANSFORMERS ARE FROM 260 to 420 VOLTS, WITH A CURRENT RATING THAT IS DANGEROUS TO LIFE.

NOTE: Trouble shooting procedures are performed with control switch in warm up position.

Possible Causes	Isolation Procedure	Correction
(1) Faulty windshield	With voltmeter set in 500-vac range, check for voltage across upper and lower windshield bus. If no voltage, proceed to step (2).	If voltage exists, replace windshield.
	Open applicable outer pane windshield heat circuit breakers. Check resistance of windshield sensing element at windshield (see Wiring Diagram Manual). If continuity exists, proceed to step (4).	If no continuity or resistance does not conform to graph, replace windshield (see Chapter 6).

Possible Causes	Isolation Procedure	Correction
C. WINDSHIELD DOES NOT HEAT WITH CONTROL SWITCH IN EITHER WARM UP OR FULL POWER POSITIONS (Continued)		
(2) Faulty wiring between windshield bus and heat transformer	Check for voltage between terminals V, W, or X and 1 of transformer. If no voltage is present, proceed to step (3).	If voltage exists, repair or replace applicable wire from transformer to windshield bus (see Wiring Diagram Manual).
(3) Faulty wiring between terminal X1 of warm up relay and ground	Check for voltage from terminal X1 of warm up relay to ground.	If voltage is present, repair or replace ground wire.
(4) Faulty temperature controller or wiring to temperature controller	Disconnect electrical connector from temperature controller. Check that resistance between pins 4 and 5 of connector is approximately same as obtained in step (1).	If resistance is not same, repair or replace applicable wire (see Wiring Diagram Manual).
		If resistance is approximately same, replace temperature controller.
	Check continuity between pin 7 of connector and ground.	If no continuity, repair or replace wire.
	Check continuity between pin 2 of connector and terminal C2 of full power relay.	If no continuity, repair or replace applicable wire (see Wiring Diagram Manual).

Possible Causes	Isolation Procedure	Correction
D. EYEBROW AND CLEARVIEW WINDOWS DO NOT HEAT WITH CONTROL SWITCH IN WARMUP OR FULL POWER POSITIONS		
(1) Faulty circuit breaker	Check for voltage at EPC upper equipment panel terminal strip (see Wiring Diagram Manual).	If no voltage exists, check circuit breaker.
(2) Faulty wiring between circuit breaker and EPC upper equipment panel terminal strip (see Wiring Diagram Manual)	Open eyebrow and clear-view window heat circuit breaker, and check continuity between circuit breaker and terminal strip.	If no continuity exists, repair or replace wire or windshield head control switch as applicable.
E. CLEARVIEW WINDOW DOES NOT HEAT WITH WINDSHIELD CONTROL SWITCH IN WARMUP OR FULL POWER POSITION. OTHER CLEARVIEW WINDOWS OPERATE NORMALLY.		
(1) Faulty window	With voltmeter set in 115-vac range, check for voltage across window buses. If no voltage, proceed to step (2).	If voltage exists, replace window.
	Open eyebrow and clear-view window heat circuit breaker. Check resistance of window sensing element at window. If continuity exists, proceed to step (2).	If no continuity, replace window.
(2) Faulty temperature controller or wiring to temperature controller	Disconnect electrical connector from temperature controller. Check that resistance between pins 4 and 5 of connector is approximately same as obtained in step (1).	If resistance is not same, repair or replace applicable wire (see Wiring Diagram Manual).



Window Heat Control Circuit -- Schematic
Figure 102

Possible Causes	Isolation Procedure	Correction
E. CLEARVIEW WINDOW DOES NOT HEAT WITH WINDSHIELD CONTROL SWITCH IN WARMUP OR FULL POWER POSITION. OTHER CLEARVIEW WINDOWS OPERATE NORMALLY. (Continued)		
		If resistance is approximately same as obtained in Step (1), replace temperature controller.
	Check continuity between pins 2 and 3 of connector and ground.	If no continuity, repair or replace applicable wire.
	Close eyebrow and window heat and clearview circuit breaker, and check for voltage at pin 7 of electrical connector.	If no voltage exists, repair or replace wire between terminal strip, located in EPC upper equipment panel and temperature controller.

WINDOWS AND WINDSHIELD ANTI-ICING/ANTIFOGGING - TROUBLE SHOOTING

1. General

A. The temperature controllers, one for each windshield are located on the EPC forward equipment panel. Three transformers, one for each windshield, and six relays, two for each windshield, are also located on the EPC forward equipment panel.

B. The anti-fog relay, one relay for all heated glass panels is located on the EPC center forward equipment panel.

C. The window anti-fog control circuit breakers located on the heat, vent, and ice protection bus section of the EPC circuit breaker panel must be opened to perform trouble shooting procedures A through E, and closed to perform procedures F through I. Opening the circuit breakers deenergizes the anti-fog electrical system so that the inner surfaces of the windshields do not heat.

WARNING: USE CARE IN MEASURING VOLTAGE BETWEEN TRANSFORMER AND HEATING ELEMENT. OUTPUT VOLTAGE OF TRANSFORMER HAS CURRENT RATING DANGEROUS TO LIFE.

2. Tools and Equipment Required

A. A multitester, model 260 Simpson or equivalent is required to perform trouble shooting procedures.

3. Trouble Shooting

NOTE: In order to accurately determine system operation, ambient temperature of the window and windshield panels should be below approximately 80°F (26.7°C) at start of the trouble shooting procedures. It is recommended that the procedures be conducted inside a hangar or in a shaded area.

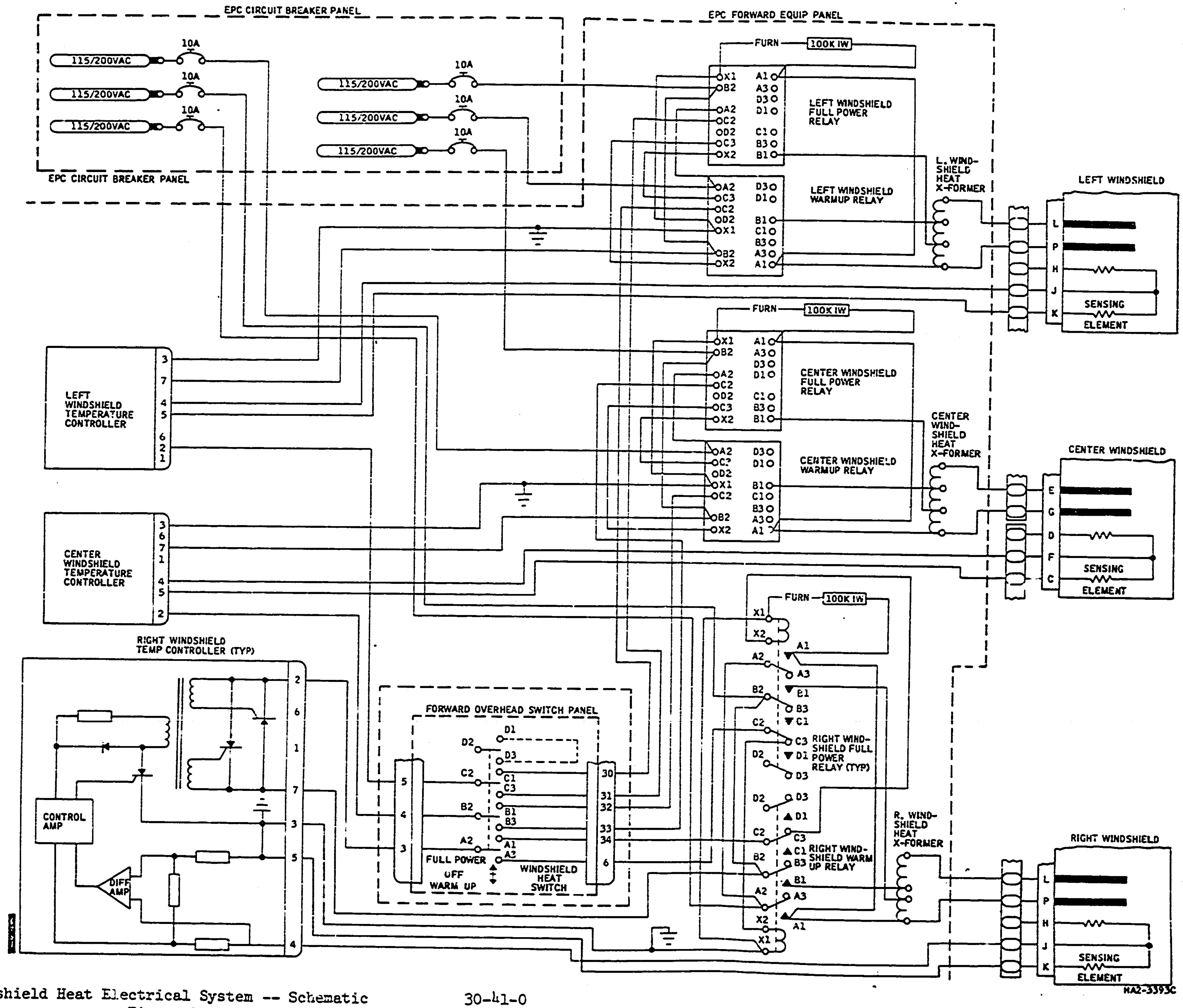
Possible Cause	Isolation Procedure	Correction
A. ALL WINDSHIELDS FAIL TO HEAT (ANTI-ICING) WITH CONTROL SWITCH IN EITHER WARM-UP OR FULL POWER POSITION		
(1) Windshield ice protection switch is defective	Check for electrical power to switch. If present, check for power at output terminals. If not present, switch is defective.	Replace switch.

Possible Cause	Isolation Procedure	Correction

B. ONE WINDSHIELD FAILS TO HEAT (ANTI-ICING) WITH CONTROL SWITCH IN EITHER WARM-UP OR FULL POWER POSITION. OTHER TWO WINDSHIELD ANTI-ICING SYSTEMS FUNCTION NORMALLY.

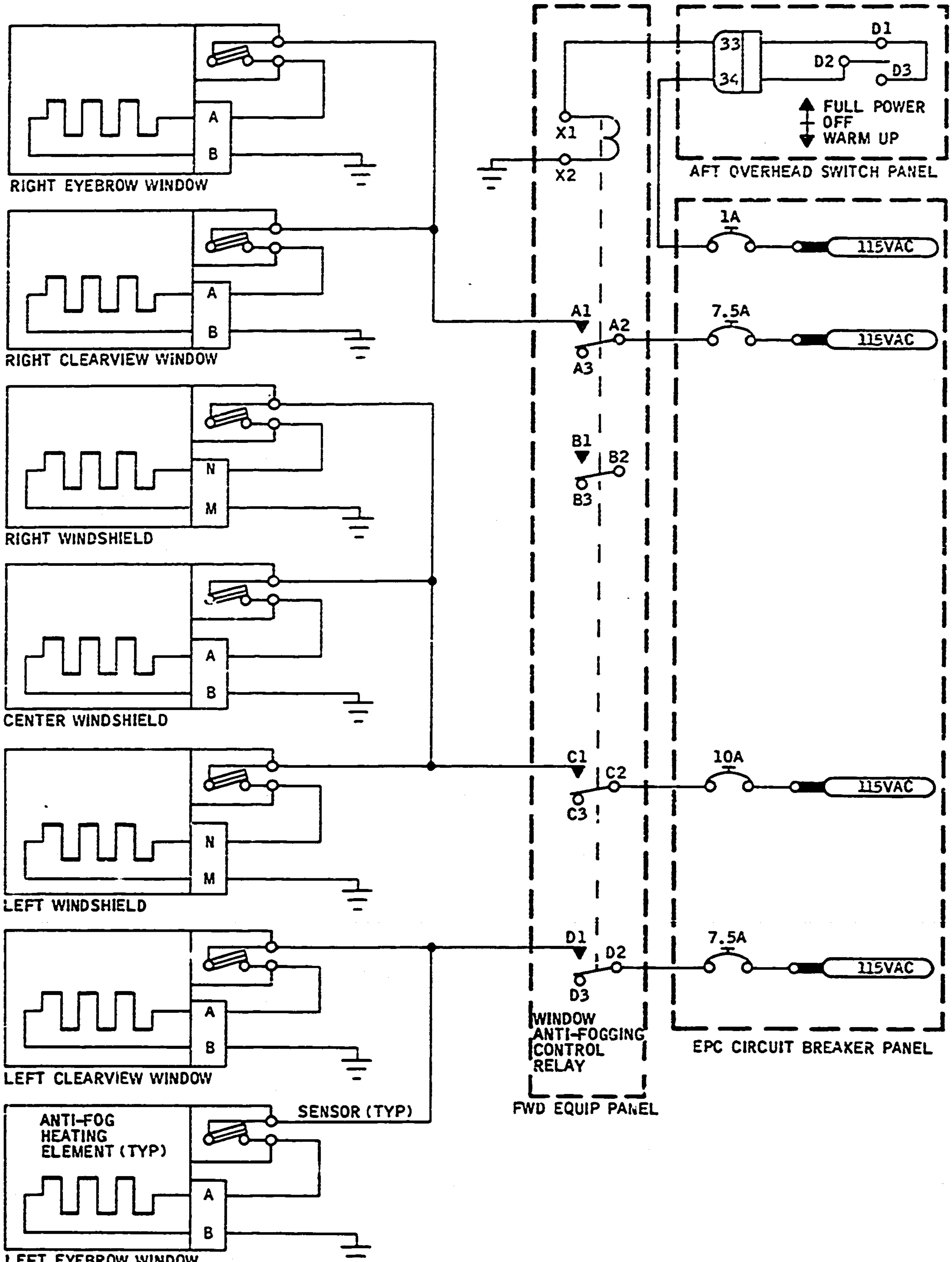
Possible Cause	Isolation Procedure	Correction
(1) Temperature sensing element is defective.	At windshield terminal strip, connect wire from controller (pin 5) to terminal with spare sensing element wire (see Wiring Diagram Manual). If windshield heats, original element is defective.	Leave spare element connected.
(2) Heating Element is defective.	With windshield heat control switch in warm-up position check for approximately 254 vac (350 vac with switch in full power position) between pins P and L of windshield electrical connector. If voltage is present check resistance of windshield heating element. Resistance should be 72 (±10) ohms for each side windshield or 80 (±12) ohms for center windshield.	If voltage is present but resistance is not correct, replace windshield.
(3) Transformer is defective.	With control switch in warm-up position, check for 195-205 vac across transformer terminals LV2 and G. (With control switch in full-power, voltage should be read across terminals LV1 and G.) If input power is normal, check for approximately 254 vac (warm-up) or 350 vac (full-power) across terminals HV and G.	If output voltage is not correct, replace transformer.

WARNING: USE CARE IN MEASURING VOLTAGE BETWEEN TRANSFORMER AND HEATING ELEMENT. OUTPUT VOLTAGE OF TRANSFORMER HAS CURRENT RATING DANGEROUS TO LIFE.



Windshield Heat Electrical System -- Schematic
Figure 1

Possible Cause	Isolation Procedure	Correction
B. ONE WINDSHIELD FAILS TO HEAT (ANTI-ICING) WITH CONTROL SWITCH IN EITHER WARM-UP OR FULL POWER POSITION. OTHER TWO WINDSHIELD ANTI-ICING SYSTEMS FUNCTION NORMALLY. (Continued)		
(4) Temperature controller is defective	Having determined that sensing circuit is good, replace controller with known good controller.	If windshield heats, replace original controller.
(5) Wiring is defective	Check electrical circuitry for continuity.	Repair or replace as necessary.
C. ONE WINDSHIELD FAILS TO HEAT (ANTI-ICING) WITH CONTROL SWITCH IN WARM-UP POSITION. OTHER TWO WINDSHIELD ANTI-ICING SYSTEMS FUNCTION NORMALLY.		
(1) Faulty windshield warm-up relay	Check continuity from terminal X1 of warm-up relay to ground. Place control switch in warm-up position and check for 115 vac at terminal X2 of relay. If voltage is not present, proceed to (2)	If voltage and continuity are present, replace relay.
(2) Faulty windshield full power relay	Check for 115 vac between full power relay terminals C1 and ground. There should be no voltage.	Presence of voltage indicates relay NO contacts are welded together or relay is energized. Replace relay or repair circuit as required.



Window and Windshield Antifogging System -- Schematic
Figure 2

Possible Cause	Isolation Procedure	Correction
D. ONE WINDSHIELD FAILS TO HEAT (ANTI-ICING) WITH CONTROL SWITCH IN FULL POWER POSITION. OTHER TWO WINDSHIELD ANTI-ICING SYSTEMS FUNCTION NORMALLY.		
(1) Faulty windshield full power relay	Check continuity from terminal X1 of full power relay to ground. Place control switch in full power position and check for 115 vac at terminal X2 of relay. If voltage is present, proceed to (2).	If voltage and continuity are present, replace relay.
(2) Faulty windshield warm-up relay	Check for 115 vac between warm-up relay terminal A1 and ground. There should be no voltage.	Presence of voltage indicates relay NO contacts are welded together or relay is energized. Replace relay or repair circuit as required.
E. RIGHT, CENTER, OR LEFT WINDSHIELD REMAINS ON WHEN WINDSHIELD HEAT CONTROL SWITCH IS OFF (ANTI-ICING).		
(1) Switch is defective	Check for electrical power at output of switch. If power is present, switch is defective.	Replace switch.
F. RIGHT, CENTER OR LEFT WINDSHIELD DOES NOT MAINTAIN STEADY TEMPERATURE (ANTIFOGGING).		
NOTE: Check that cockpit window antifog control circuit breakers are closed before performing steps F through I.		
(1) Thermoswitch is defective.	If thermoswitch is suspected due to intermittent heating of windshield, install	Leave new thermoswitch installed.

	Possible Cause	Isolation Procedure	Correction
F.	RIGHT, CENTER OR LEFT WINDSHIELD DOES NOT MAINTAIN STEADY TEMPERATURE (ANTIFOGGING). (Continued)		
		thermoswitch known to be serviceable. If steady temperature is maintained, original thermoswitch is defective.	
G.	RIGHT, CENTER, AND LEFT WINDSHIELD, RIGHT AND LEFT EYEBROW AND CLEARVIEW WINDOWS FAIL TO HEAT (ANTIFOGGING)		
(1)	Windshield heat control switch defective.	Check for electrical power to switch. If present, check for power at output terminals. If not present, switch is defective.	Replace switch.
(2)	Windshield defog control relay.	Check for electrical power at relay. If present, and relay is inoperative, relay is defective.	Replace relay.
H.	RIGHT, CENTER OR LEFT WINDSHIELD, RIGHT OR LEFT EYEBROW OR CLEARVIEW WINDOW FAILS TO HEAT (ANTIFOGGING)		
(1)	Thermal switch is defective.	Check for electrical power at input terminal of thermal switch. If present, check for power at output terminal of switch. If power not present, switch is defective.	Replace thermal switch.
(2)	Heating element is defective.	Check for electrical power (105-115 Vac) at heating element. If present, element is defective.	Replace windshield or window as applicable.
(3)	Wiring is defective.	Check electrical circuitry for continuity.	Repair or replace wiring as necessary.

Possible Cause	Isolation Procedure	Correction
I. RIGHT, CENTER, AND LEFT WINDSHIELD RIGHT AND LEFT EYEBROW AND CLEARVIEW WINDOW HEAT REMAINS ON WHEN WINDSHIELD HEAT CONTROL SWITCH IS OFF (ANTIFOGGING)		
(1) Switch is defective.	Check for electrical power at output of switch. If power is present, switch is defective.	Replace switch

WINDOWS AND WINDSHIELD ANTI-ICING/ANTIFOGGING - TROUBLE SHOOTING

1. General

A. The temperature controllers, one for each windshield are located on the EPC forward equipment panel. Three transformers, one for each windshield, and six relays, two for each windshield, are also located on the EPC forward equipment panel.

B. The anti-fog relay, one relay for all heated glass panels is located on the EPC center forward equipment panel.

C. The over/under temperature detector, one detector for all heated glass panels, is located on the EPC forward equipment panel.

D. The window anti-fog control circuit breakers located on the heat, vent, and ice protection bus section of the EPC circuit breaker panel must be opened to perform trouble shooting procedures A through E, and closed to perform procedures F through I. Opening the circuit breakers deenergizes the anti-fog electrical system so that the inner surfaces on the windshields do not heat.

WARNING: USE CARE IN MEASURING VOLTAGE BETWEEN TRANSFORMER AND HEATING ELEMENT. OUTPUT VOLTAGE OF TRANSFORMER HAS CURRENT RATING DANGEROUS TO LIFE.

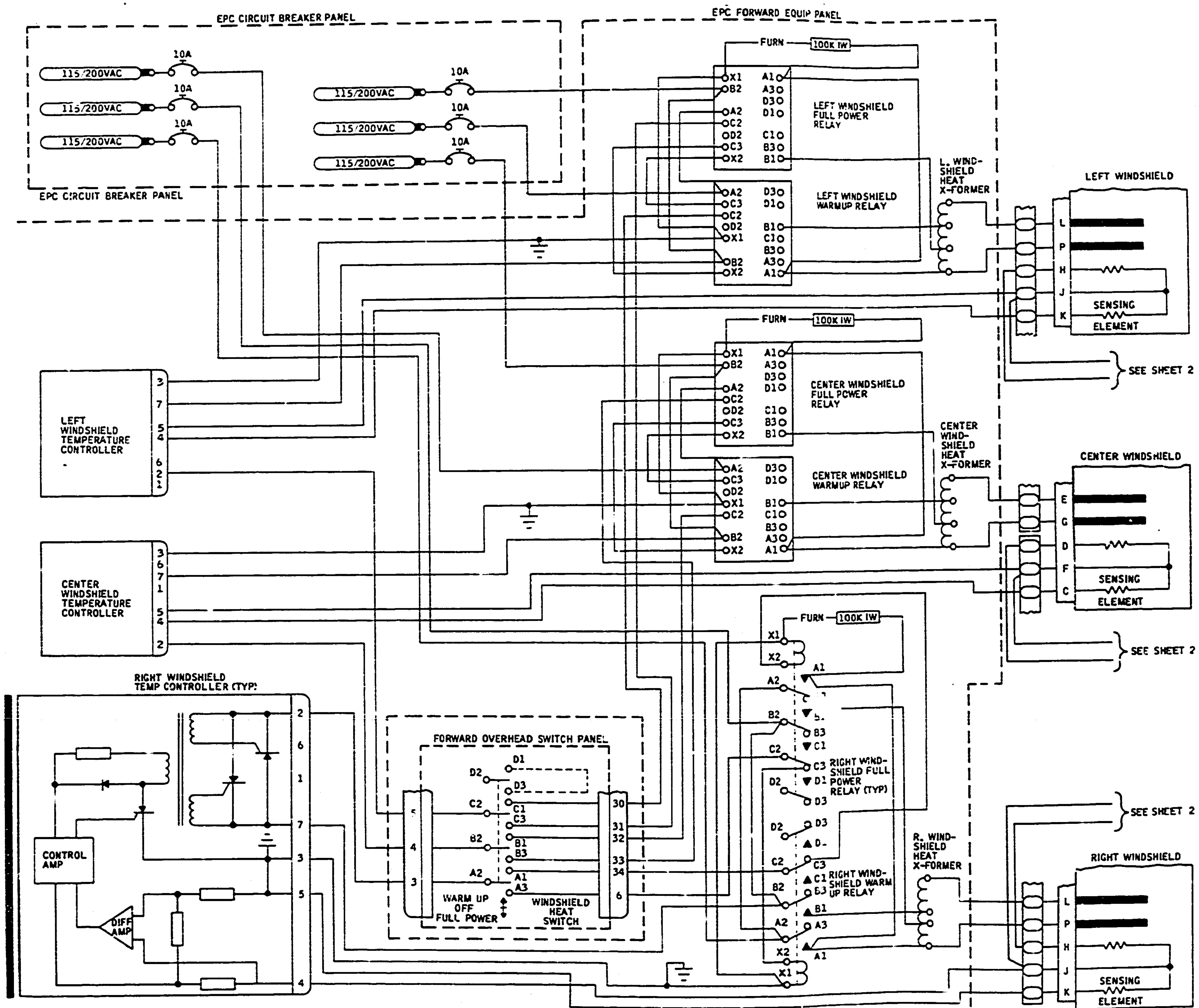
2. Tools and Equipment Required

A. A multitester, model 260 Simpson or equivalent is required to perform trouble shooting procedures.

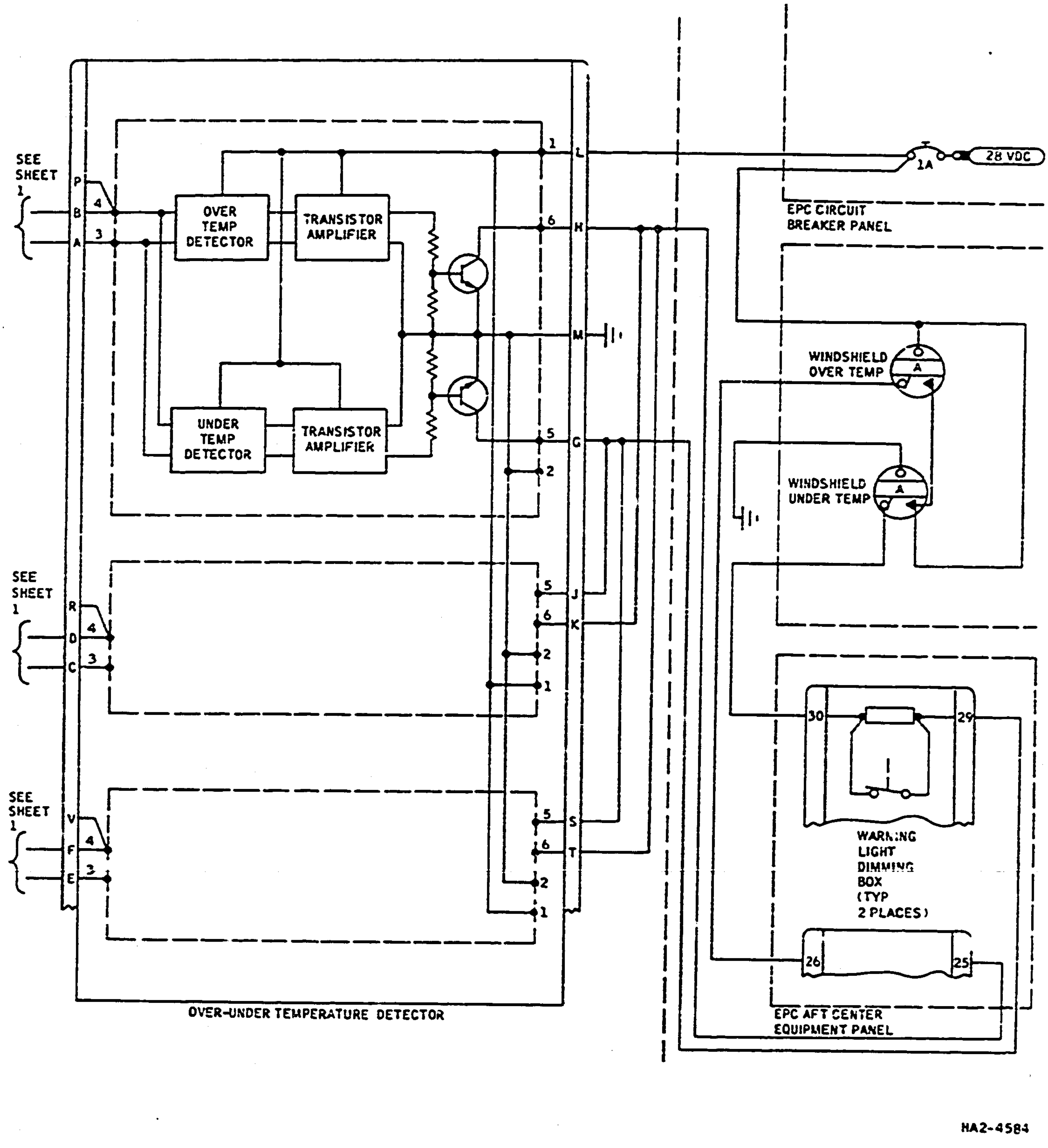
3. Trouble Shooting

NOTE: In order to accurately determine system operation, ambient temperature of the window and windshield panels should be below approximately 80°F (26.7°C) at start of the trouble shooting procedures. It is recommended that the procedures be conducted inside a hanger or in a shaded area.

Possible Cause	Isolation Procedure	Correction
A. ALL WINDSHIELDS FAIL TO HEAT (ANTI-ICING) WITH CONTROL SWITCH IN EITHER WARM-UP OR FULL POWER POSITION.		
(1) Windshield ice protection switch is defective.	Check for electrical power to switch. If present, check for power at output terminals. If not present, switch is defective.	Replace switch.
B. ONE WINDSHIELD FAILS TO HEAT (ANTI-ICING) WITH CONTROL SWITCH IN EITHER WARM-UP OR FULL POWER POSITION. OTHER TWO WINDSHIELD ANTI-ICING SYSTEMS FUNCTION NORMALLY.		
(1) Temperature sensing element is defective.	Disconnect sensing element wires from terminal strip (see Wiring Diagram Manual). Check continuity through sensing element.	If no continuity, replace windshield.
(2) Heating Element is defective.	With windshield heat control switch in warm-up position check for approximately 254 vac (350 vac with switch in full power position) between pins P and L of windshield electrical connector. If voltage is present check resistance of windshield heating element. Resistance should be 72 (±10) ohms for each side windshield or 80 (±12) ohms for center windshield.	If voltage is present but resistance is not correct, replace windshield.



Windshield Heat Electrical System -- Schematic
Figure 1 (Sheet 1)

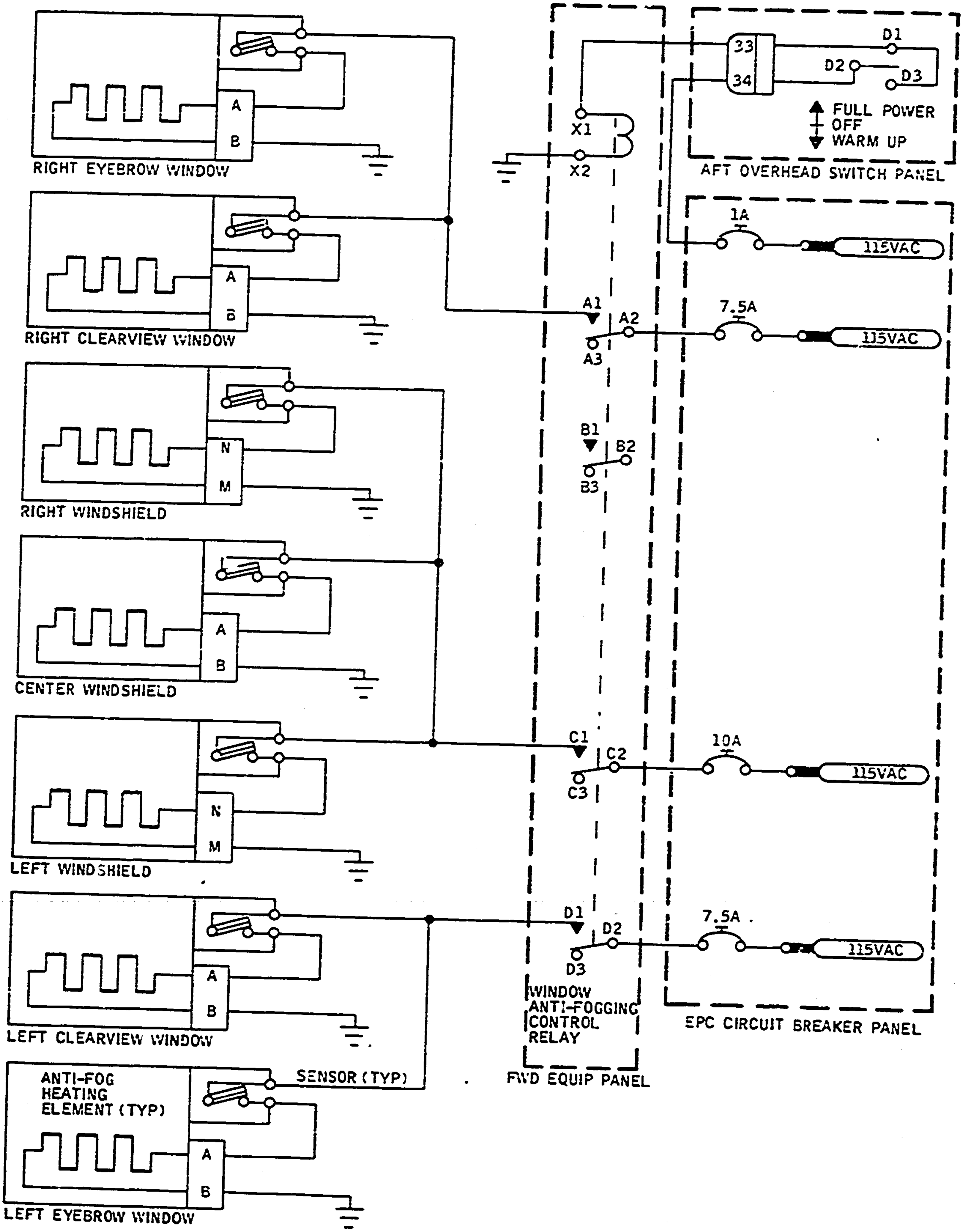


Windshield Heat Electrical System -- Schematic
Figure 1 (Sheet 2)

Possible Cause	Isolation Procedure	Correction
B. ONE WINDSHIELD FAILS TO HEAT (ANTI-ICING) WITH CONTROL SWITCH IN EITHER WARM-UP OR FULL POWER POSITION. OTHER TWO WINDSHIELD ANTI-ICING SYSTEMS FUNCTION NORMALLY. (Continued)		
(3) Transformer is defective.	With control switch in warm-up position, check for 195-205 vac across transformer terminals LV2 and G. (With control switch in full-power, voltage should be read across terminals LV1 and G.) If input power is not normal, check for approximately 254 vac (warm-up) or 330 vac (full-power) across terminals HV and G.	If output voltage is not correct replace transformer.

WARNING: USE CARE IN MEASURING VOLTAGE BETWEEN TRANSFORMER AND HEATING ELEMENT. OUTPUT VOLTAGE OF TRANSFORMER HAS CURRENT RATING DANGEROUS TO LIFE.

Possible Cause	Isolation Procedure	Correction
(4) Temperature controller is defective.	Having determined that sensing circuit is good, replace controller with known good controller.	If windshield heats, replace original controller.
(5) Wiring is defective.	Check electrical circuitry for continuity.	Repair or replace as necessary.
C. ONE WINDSHIELD FAILS TO HEAT (ANTI-ICING) WITH CONTROL SWITCH IN WARM-UP POSITION. OTHER TWO WINDSHIELD ANTI-ICING SYSTEMS FUNCTION NORMALLY.		
(1) Faulty windshield warm-up relay	Check continuity from terminal X1 of warm-up relay to ground. Place control switch in warm-up position and check for 115 vac at terminal X2 of relay. If voltage is not present, proceed to (2).	If voltage and continuity are present, replace relay.



HA2-3394

Window and Windshield Antifogging System -- Schematic
Figure 2

Possible Cause	Isolation Procedure	Correction
C. ONE WINDSHIELD FAILS TO HEAT (ANTI-ICING) WITH CONTROL SWITCH IN WARM-UP POSITION. OTHER TWO WINDSHIELD ANTI-ICING SYSTEMS FUNCTION NORMALLY. (Continued)		
(2) Faulty windshield full power relay	Check for 115 vac between full power relay terminals C1 and ground. There should be no voltage.	Presence of voltage indicates relay NO contacts are welded together or relay is energized. Replace relay or repair circuit as required.
D. ONE WINDSHIELD FAILS TO HEAT (ANTI-ICING) WITH CONTROL SWITCH IN FULL POWER POSITION. OTHER TWO WINDSHIELD ANTI-ICING SYSTEMS FUNCTION NORMALLY.		
(1) Faulty windshield full power relay.	Check continuity from terminal X1 of full power relay to ground. Place control switch in full power position and check for 115 vac at terminal X2 of relay. If voltage is present, proceed to (2).	If voltage and continuity are present, replace relay.
(2) Faulty windshield warm-up relay	Check for 115 vac between warm-up relay terminal A1 and ground. There should be no voltage.	Presence of voltage indicates relay NO contacts are welded together or relay is energized. Replace relay or repair circuit as required.

Possible Cause	Isolation Procedure	Correction
E. RIGHT, CENTER, OR LEFT WINDSHIELD REMAINS ON WHEN WINDSHIELD HEAT CONTROL SWITCH IS OFF (ANTI-ICING).		
(1) Switch is defective.	Check for electrical power at output of switch. If power is present, switch is defective.	Replace switch.
F. RIGHT, CENTER, OR LEFT WINDSHIELD DOES NOT MAINTAIN STEADY TEMPERATURE (ANTIFOGGING).		
NOTE: Check that cockpit window antifog control circuit breakers are closed before performing steps F through I.		
(1) Thermoswitch is defective.	If thermoswitch is suspected due to intermittent heating of windshield, install thermoswitch known to be serviceable. If steady temperature is maintained, original thermoswitch is defective.	Leave new thermoswitch installed.
G. RIGHT, CENTER, AND LEFT WINDSHIELD, RIGHT AND LEFT EYEBROW AND CLEARVIEW WINDOWS FAIL TO HEAT (ANTIFOGGING).		
(1) Windshield heat control switch defective.	Check for electrical power to switch. If present, check for power at output terminals. If not present, switch is defective.	Replace switch.
(2) Windshield defog control relay.	Check for electrical power at relay. If present, and relay is inoperative, relay is defective.	Replace relay.

	Possible Cause	Isolation Procedure	Correction
H.	RIGHT, CENTER, OR LEFT WINDSHIELD, RIGHT OR LEFT EYEBROW OR CLEARVIEW WINDOW FAILS TO HEAT (ANTIFOGGING)		
(1)	Thermal switch is defective.	Check for electrical power at input terminal of thermal switch. If present, check for power at output terminal of switch. If power not present, switch is defective.	Replace thermal switch.
(2)	Heating element is defective.	Check for electrical power (105-115 vac) at heating element. If present, element is defective.	Replace windshield or window as applicable.
(3)	Wiring is defective.	Check electrical circuitry for continuity.	Repair or replace wiring as necessary.
I.	RIGHT, CENTER, AND LEFT WINDSHIELD RIGHT AND LEFT EYEBROW AND CLEARVIEW WINDOW HEAT REMAINS ON WHEN WINDSHIELD HEAT CONTROL SWITCH IS OFF (ANTIFOGGING)		
(1)	Switch is defective	Check for electrical power at output of switch. If power is present, switch is defective.	Replace switch.
J.	WINDSHIELD OVER OR UNDER TEMPERATURE LIGHT FAILS TO COME ON, RIGHT, CENTER, OR LEFT WINDSHIELD HEAT ABNORMAL.		
(1)	Lamp defective.	Install lamp known to be serviceable.	Leave new lamp installed.
(2)	Windshield over/under temperature detector defective.	Install detector known to be serviceable.	Leave new detector installed.

Possible Cause	Isolation Procedure	Correction
J. WINDSHIELD OVER OR UNDER TEMPERATURE LIGHT FAILS TO COME ON, RIGHT, CENTER, OR LEFT WINDSHIELD HEAT ABNORMAL (Continued)		
(3) Light circuitry defective.	Check wiring between over/ under temperature lights and detector (see Wiring Diagram Manual).	Repair or replace as necessary.
K. WINDSHIELD OVER OR UNDER TEMPERATURE LIGHT ON, RIGHT, CENTER, AND LEFT WINDSHIELD TEMPERATURE NORMAL		
(1) Windshield over/ under temperature detector defective.	Install detector known to be serviceable.	Leave new detector installed.
(2) Light circuitry defective.	Disconnect wire to detector, if light remains on, light circuit is grounded.	Repair or replace as necessary.

WINDOWS AND WINDSHIELDS ANTI-ICING/ANTIFOGGING - MAINTENANCE PRACTICES

1. General

A. The conductors to which the ohmmeter is attached are located in the electrical power center equipment panels. Access to the applicable portions of the panels is through access door 623 and access door 633.

WARNING: OUTPUT VOLTAGES OF WINDSHIELD TRANSFORMERS ARE FROM 250 TO 450 VOLTS WITH A CURRENT RATING THAT IS DANGEROUS TO LIFE.

2. Tools and Equipment Required

A. An ohmmeter (0 to 200 ohms range) is used to measure resistance.

3. Adjustment/Test Windshield and Windows Anti-Icing/Anti-Fogging System

A. Test Terminal-Transformer-System

(1) Open outer pane windshield heat (right, center, and left) circuit breakers (six breakers), located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

(2) Check for current flow in each windshield and/or window heating circuit as follows:

NOTE: The duration and frequency of current flow periods depend on the temperature of panel and other variable factors. Current flow period may be as short as 1 second, and if ambient temperature is relatively high, no current may be evident for as long as 20 minutes. Heating systems does not operate at panel temperatures above approximately 100°F (37.8°C).

(a) Apply snap-around type ammeter to conductor indicated in substep (c) for windshield or window to be checked.

(b) Close applicable circuit breaker(s).

(c) Place windshield heat control switch in warm up, then in full power position. Ammeter readings should be as follows:

CAUTION: LIMIT FULL POWER OPERATION TO 5 SECONDS.

(d) Place windshield heat control switch in off position; no current should flow.

(e) Open applicable circuit breaker.

(f) Remove ammeter.

(3) Close outer pane windshield heat (right, center, and left) circuit breakers (six breakers), located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

Circuit (Circuit Breaker)	Apply ammeter to conductor	Ammeter Reading	
		WARM UP	FULL POWER
Left windshield (left outer pane windshield heat)	HV-H732	3.1 to 4.8	5.0 to 8.1
Right windshield (right outer pane windshield heat)	HV-H700	3.1 to 4.8	5.0 to 8.1
Center windshield (center outer pane windshield)	HV-H702	2.8 to 4.6	4.7 to 7.7
Left eyebrow (eyebrow and clearview window heat)	HV-H369	0.53 to 1.1	0.53 to 1.1
Right eyebrow (eyebrow and clearview window heat)	HV-H354	0.53 to 1.1	0.53 to 1.1
Left clearview (eyebrow and clearview window heat)	HV-H364	0.53 to 1.1	0.53 to 1.1
Right clearview (eyebrow and clearview window heat)	HV-H359	0.53 to 1.1	0.53 to 1.1

WINDOWS AND WINDSHIELD ANTI-ICING/ANTIFOGGING -

MAINTENANCE PRACTICES

1. General

A. The three windshield panels (left, center, and right), the two eyebrow windows, and the two clearview windows are electrically heated. The heating element coatings are fused between the glass plys and terminal blocks and are provided at the corners of the panels. A defective heating element entails replacement of the glass panel.

B. Each of the three windshields is equipped with two integral temperature-sensing elements. Only one sensing element is used at a time. If one element becomes defective, the airplane wiring may be disconnected at the windshield terminal strip and connected into the standby element circuit.

C. A thermal switch is attached with a spring clip to the inside surface of each of the three windshields, the upper windows, and the two clearview windows. Two terminal screws are provided on each thermal switch for wiring connections.

D. Temperature controllers, one for each windshield, are located on the EPC forward equipment panel.

E. Three transformers, one for each windshield, are located on the EPC forward equipment panel. Six relays, two for each windshield, are located on the EPC forward equipment panel.

F. The antifog relay, one relay for all heated glass panels, is located on the EPC forward equipment panel.

G. Circuit breakers for windshield and window heating are located on the heat, vent, and ice protection bus of the EPC circuit breaker panel.

H. The windshield heat control switch is located on the forward overhead switch panel.

WARNING: OUTPUT VOLTAGES OF WINDSHIELD TRANSFORMERS HAVE A CURRENT RATING THAT IS DANGEROUS TO LIFE.

I. An alternate method of adjustment test is provided, using the Douglas dynamic windshield temperature - line checker. Adjustment/test procedures using the line checker for the left, center, and right windshields are identical.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Multiple range potentiometer indicator		Leeds & Northrup Co.	Test windshield antifogging system
B	Thermocouple Switch (7 position)			Test windshield antifogging system
C	Thermocouple Wire			Test windshield antifogging system
D	Metal tape		Mystik	Test windshield antifogging system
E	Neon Lamp (7 required)	NE-51H		Test windshield antifogging system
F	Multimeter	630A	Triplett	Test windshield antifogging system
G	Stopwatch			Test windshield antifogging system
H	Ohmmeter, (0-200 ohm range)			Test windshield anti-icing system
J	Ammeter, snap around type (0-10 amperes, 125 to 250 volt range)			Test windshield anti-icing system
K	Dynamic windshield temperature-line checker	4889798	Douglas Aircraft Co., Inc.	Test windshield anti-icing system

3. Adjustment/Test Windshield and Windows Anti-Icing/Antifogging System

NOTE: In order to accurately determine system operation, ambient temperature of the window and windshield panels should be below approximately 80°F (26.7°C) at start of the trouble shooting procedures. It is recommended that the procedures be conducted inside a hangar or in a shaded area.

A. Test Windshield Anti-Icing System

(1) Open window antifogging and windshield heat (right, center, and left) circuit breakers, located on heat, vent and ice protection (ac bus) section of circuit breaker panel.

WARNING: OUTPUT VOLTAGES OF WINDSHIELD TRANSFORMERS HAVE A CURRENT RATING THAT IS DANGEROUS TO LIFE.

(2) Disconnect wire from HV terminal on right windshield transformer.

(3) Using ohmmeter check resistance between wire and transformer terminal G. Resistance should be 72 (±10.8) ohms.

(4) Connect wire to HV terminal on right windshield transformer.

(5) Disconnect wire from HV terminal on left windshield transformer.

(6) Using ohmmeter check resistance between wire and transformer terminal G. Resistance should be 72 (±10.8) ohms.

(7) Connect wire to HV terminal on left windshield transformer.

(8) Disconnect wire from HV terminal on center windshield transformer.

(9) Using ohmmeter check resistance between wire and transformer terminal G. Resistance should be 80 (±12.5) ohms.

(10) Connect wire to HV terminal on center windshield transformer.

(11) Check for current flow in each windshield heating circuit as follows:

NOTE: The duration and frequency of current flow periods depend on the temperature of panel and other variable factors. Current flow period may be as short as 1 second, and if ambient temperature is relatively high, no current may be evident for as long as 20 minutes. Heating systems does not operate at panel temperatures above approximately 100°F (37.8°C).

(a) Apply snap-around type ammeter to one conductor indicated in substep (c) for windshield to be checked.

(b) Close windshield heat circuit breakers corresponding to windshield under test.

(c) Place windshield heat control switch in positions indicated; ammeter readings should be as follows:

Circuit (Circuit Breaker)	Apply ammeter to conductor	Ammeter Reading With Switch In		
		OFF	WARM UP	FULL POWER
Left windshield (left outer pane windshield heat)	HV-H702 HV-H733	Not more than 1.5	3.8 to 5.3 3.8 to 5.3	6.5 to 9.0 6.5 to 9.0
Right windshield (right outer pane windshield heat)	HV-H700 HV-H731	Not more than 1.5	3.8 to 5.3 3.8 to 5.3	6.5 to 9.0 6.5 to 9.0
Center windshield (center outer pane windshield heat)	HV-H701 HV-H732	Not more than 1.5	3.4 to 4.8 3.4 to 4.8	5.8 to 8.1 5.8 to 8.1

(d) Place windshield heat control switch in off position.

(e) Open applicable circuit breakers.

(f) Remove ammeter.

(g) Repeat substeps (a through f) for remaining conductors.

(12) Close window antifogging and windshield heat (right, center, and left) circuit breakers located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

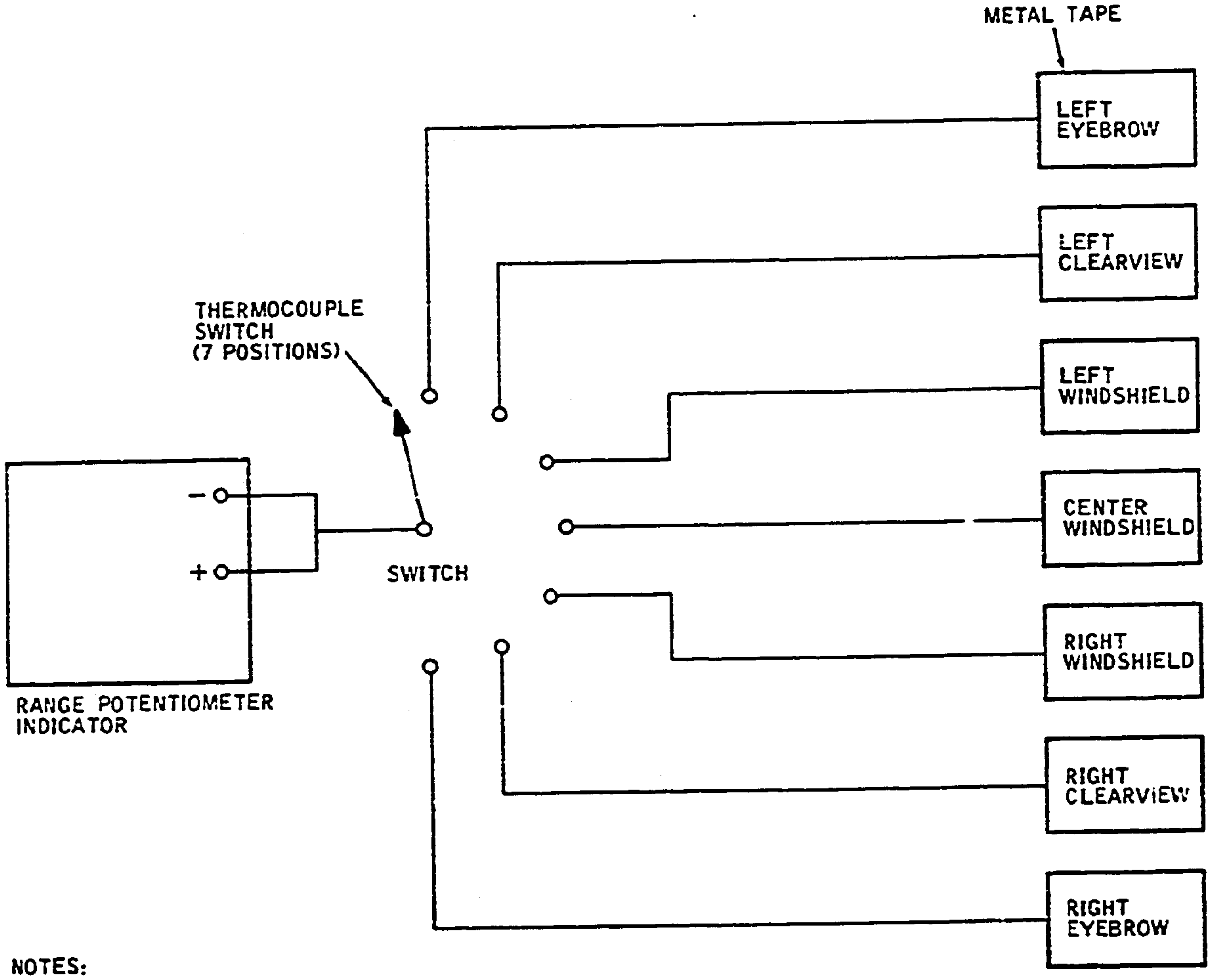
B. Test Windshield Antifogging System

(1) Open windshield heat (right, center, and left) circuit breakers, located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

(2) Connect range potentiometer (see Figure 201).

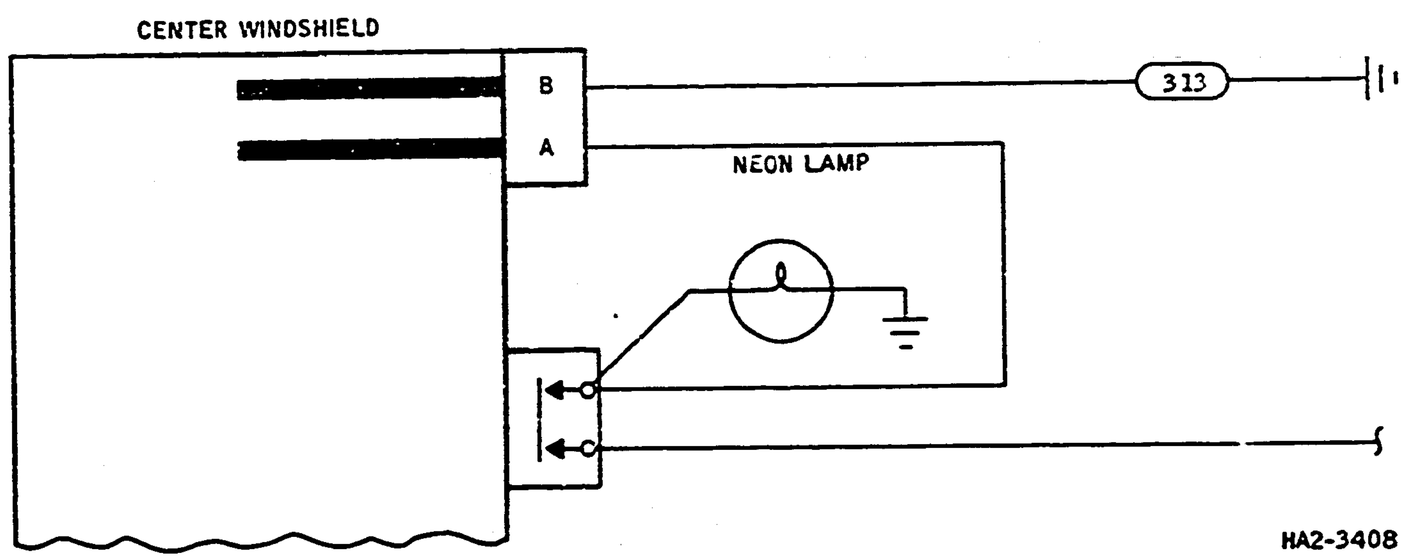
(3) Connect neon lamps (see Figure 201).

(4) Rotate thermocouple switch to each switch position and record ambient temperature in column 1 of recording chart (see Figure 202).



NOTES:

1. APPROXIMATELY 1 INCH SQUARE PIECE OF METAL TAPE TO BE USED ON THE INSIDE OF EACH WINDOW.
2. TAPE TO BE LOCATED TOWARD CENTER OF WINDOW WITHIN 1 INCH OF THERMO-SWITCH



HA2-3408

Windows and Windshields Antifogging Test Assemblies -- Schematic
Figure 201

Window	1. Ambient (Temp.)	2. Light Off (Temp.)	3. Light On (Temp.)	4. Light Off Temp. Tolerance	5. Light On Temp. Tolerance
Center Windshield				100°-140°	85°-105°
Right Windshield				100°-140°	85°-105°
Left Windshield				100°-140°	85°-105°
Right Clearview				100°-140°	85°-105°
Left Clearview				100°-140°	85°-105°
Right Eyebrow				100°-140°	85°-105°
Left Eyebrow				100°-140°	85°-105°

Windows and Windshields Antifogging --
Recording Chart
Figure 202

(5) Place windshield heat control switch in warm up position and simultaneously start stop watch. Neon indicator lamps should illuminate.

(6) As each neon lamp extinguishes, turn thermocouple switch to corresponding window and record temperature in column 2 of recording chart. Temperatures should be within tolerances shown in column 4 of recording chart.

CAUTION: IF ANY OF NEON LAMPS HAVE NOT EXTINGUISHED WITHIN 20 MINUTES OR ANY WINDOW TEMPERATURES HAVE RISEN TO 150°F, OPEN WINDOW ANTIFOG CIRCUIT BREAKERS.

(7) After each neon lamp extinguishes, it will again illuminate (within approximately 10 minutes). When lamp illuminates, turn thermocouple switch to corresponding window and record temperature. Temperatures should be within tolerances shown in column 5 of recording chart.

NOTE: If neon indicator lamps are extinguishing and illuminating at to close intervals, close one of window antifog circuit breakers and perform tests on left eyebrow, left clearview and left windshield. Then on right windshield, right clearview, right eyebrow and center windshield.

(8) Place windshield heat control switch in off position.

(9) Disconnect neon lamps.

(10) Disconnect range potentiometer.

(11) Close windshield heat (right, center, and left) circuit breakers, located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

4. Alternate Adjustment/Test Using Dynamic Windshield Temperature - Line Checker

A. Test Windshield

(1) Open window antifogging and windshield heat (right, center, and left) circuit breakers, located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

WARNING: OUTPUT VOLTAGES OF WINDSHIELD HAVE A CURRENT RATING THAT IS DANGEROUS TO LIFE.

(2) Connect line checker between applicable windshield controller and airplane wiring.

(3) Connect red clip lead to terminal G of applicable windshield transformer.

(4) Connect black clip lead to structural ground.

(5) Make certain airplane windshield heat selector switch is in off position.

(6) Close applicable windshield heat circuit breakers. Line checker system power light should come on (controller power light may also come on).

CAUTION: REMAINING FOUR WINDSHIELD HEAT CIRCUIT BREAKERS MUST REMAIN OPEN.

(7) Hold checker ambient 110°F +/normal/meter check switch in meter check position, and hold read temperature/normal switch in read temperature position. Windshield temperature meter should read 105(±5)°F. Release switches.

NOTE: If ambient temperature is 110°F or above, steps (8 through 20) are to be performed with checker ambient 110°F +/normal/meter check switch held in the ambient 110°F + position. Ambient 110°+ switch position alters windshield temperature sensor resistance to value approximately 43 degrees lower than actual temperature, thus at indicated shutoff point of approximately 105°F, actual windshield temperature is approximately 148°F. Checker will not allow temperature of windshield panel to rise above safe limit of 180°F.

(8) Hold read temperature /normal switch in read temperature position. Record meter reading.

NOTE: This is "cold" glass temperature and should be within ±20°F to outside ambient temperature.

(9) Return read temperature/normal switch to normal position.

(10) Actuate sense element ground test switch. Grounded light should not come on.

NOTE: Grounded light will come on if element is grounded through any path less than 30,000 ohms. Ground must be cleared before proceeding. Perform steps (11 through 17) quickly and in sequence to complete system analysis before controller shuts off.

(11) Place windshield heat switch in warm up position. Controller output power and transformer primary power lights, on line checker, should come on.

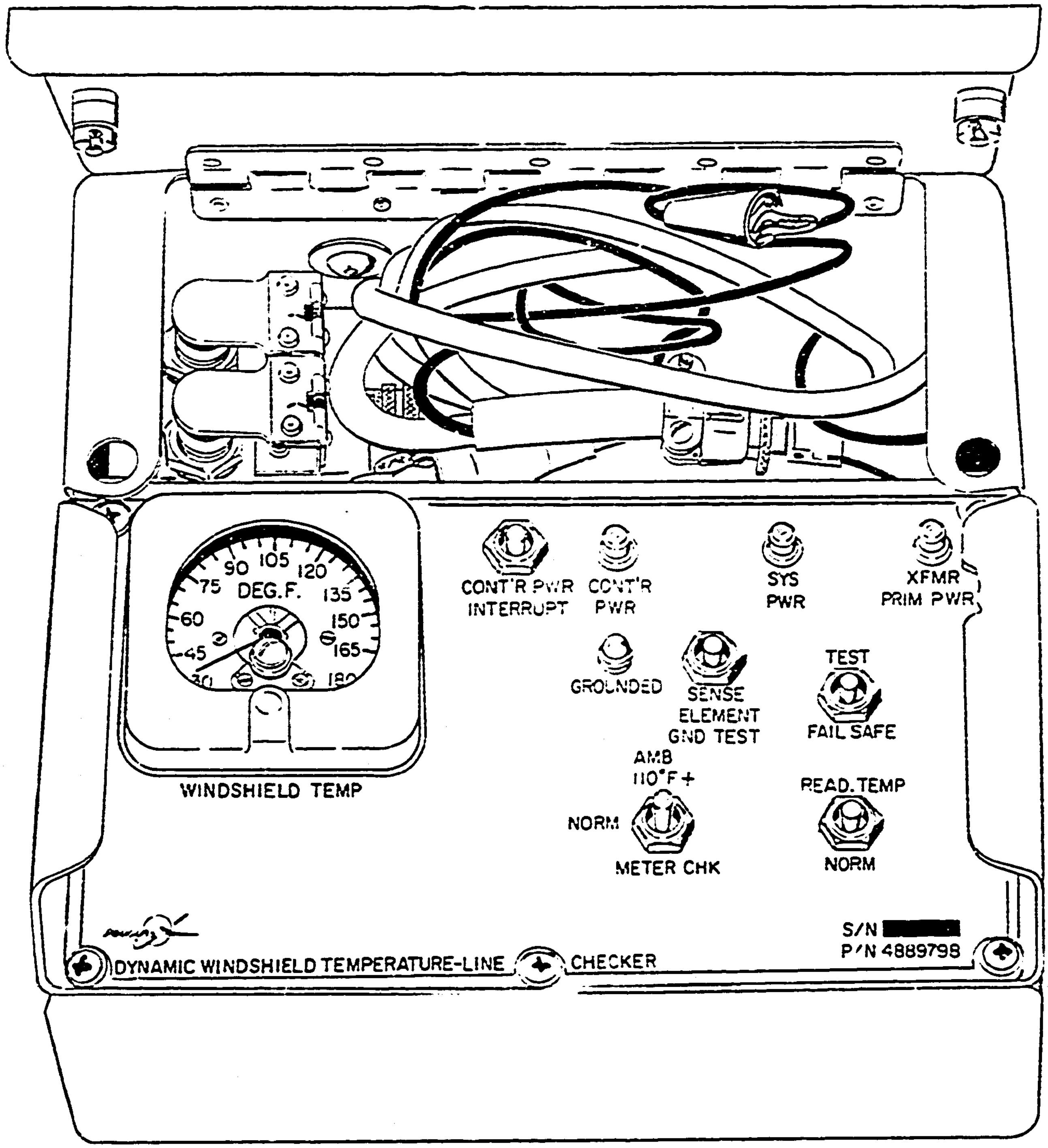
(12) Place read temperature/normal switch in read temperature position. Controller output power and transformer primary power lights should go off.

(13) Return switch to normal. Controller output power and transformer primary power lights should come on.

(14) Place fail safe switch in test position. Controller output power and transformer primary power lights should go off.

(15) Release fail safe switch to neutral position. Controller output power and transformer primary power lights should come on.

(16) Approximately ten seconds after controller output and transformer primary power lights come on, place read temperature/normal switch in read temperature position. Temperature reading should show increase over reading recorded in step (8).



Dynamic Windshield Temperature -- Line Checker
Figure 203

(17) With controller output power and transformer primary power lights on, actuate controller power interrupt switch. Both lights should go off. Release switch.

(18) As windshield continues to heat take frequent temperature readings by placing read temperature/normal switch in read temperature position. Return switch as quickly as possible. Output power and transformer primary power lights should go off when meter indicator reaches 105(±10)°F.

NOTE: Power is off and windshield is cooling while switch is in read temperature position.

(19) Continue to observe lights. When lights come on take quick temperature reading. Meter should indicate 95(±10)°F.

(20) Repeat steps (11 through 19) with airplane windshield heat switch in full power position.

(21) Place windshield heat switch in off position.

(22) Open applicable windshield heat circuit breakers.

(23) Disconnect line checker.

(24) Close window antifogging and windshield heat (right, center, and left) circuit breakers.

WINDOWS AND WINDSHIELD ANTI-ICING/ANTIFOGGING -

MAINTENANCE PRACTICES

1. General

A. The three windshield panels (left, center, and right), the two eyebrow windows, and the two clearview windows are electrically heated. The heating element coatings are fused between the glass plys and terminal blocks and are provided at the corners of the panels. A defective heating element entails replacement of the glass panel.

B. Each of the three windshields is equipped with two integral temperature-sensing elements. One sensing element is used for heat control, the other is used for the over/under temperature detector.

C. A thermal switch is attached with a spring clip to the inside surface of each of the three windshields, the upper windows, and the two clearview windows. Two terminal screws are provided on each thermal switch for wiring connections.

D. Temperature controllers, one for each windshield, are located on the EPC forward equipment panel.

E. Three transformers, one for each windshield, are located on the EPC forward equipment panel. Six relays, two for each windshield, are located on the EPC forward equipment panel.

F. The antifog relay, one relay for all heated glass panels, is located on the EPC forward equipment panel.

G. Windshield over/under temperature detector is located on the EPC forward equipment panel.

H. Circuit breakers for windshield and window heating are located on the heat, vent, and ice protection bus of the EPC circuit breaker panel.

I. The windshield heat control switch is located on the forward overhead switch panel.

J. An alternate method of adjustment test is provided, using the Douglas dynamic windshield temperature - line checker. Adjustment/test procedures using the line checker for the left, center, and right windshields are identical.

WARNING: OUTPUT VOLTAGES OF WINDSHIELD TRANSFORMERS HAVE A CURRENT RATING THAT IS DANGEROUS TO LIFE.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Multiple range potentiometer indicator		Leeds & Northrup Co.	Test windshield antifogging system
B	Thermocouple Switch (7 position)			Test windshield antifogging system
C	Thermocouple Wire			Test windshield antifogging system
D	Metal tape		Mystik	Test windshield antifogging system
E	Neon Lamp (7 required)	NE-51H		Test windshield antifogging system
F	Multimeter	630A	Triplett	Test windshield antifogging system
G	Stopwatch			Test windshield antifogging system
H	Ohmmeter, (0-200 ohm range)			Test windshield anti-icing system
J	Ammeter, snap around type (0-10 amperes, 125 to 250 volt range)			Test windshield anti-icing system
K	Dynamic windshield temperature-line checker	4889798	Douglas Aircraft Co., Inc.	Test windshield anti-icing system
L	Ice			Test over/under temperature detector

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3. Adjustment/Test Windshield and Windows Anti-Icing/Antifogging System

NOTE: In order to accurately determine system operation, ambient temperature of the window and windshield panels should be below approximately 80°F (26.7°C) at start of the trouble shooting procedures. It is recommended that the procedures be conducted inside a hanger or in a shaded area.

A. Test Windshield Anti-Icing System

(1) Open window antifogging and windshield heat (right, center, and left) circuit breakers, located on heat, vent and ice protection (ac bus) section of circuit breaker panel.

WARNING: OUTPUT VOLTAGES OF WINDSHIELD TRANSFORMERS HAVE A CURRENT RATING THAT IS DANGEROUS TO LIFE.

(2) Disconnect wire from HV terminal on right windshield transformer.

(3) Using ohmmeter check resistance between wire and transformer terminal G. Resistance should be 72 (±10.8) ohms.

(4) Connect wire to HV terminal on right windshield transformer.

(5) Disconnect wire from HV terminal on left windshield transformer.

(6) Using ohmmeter check resistance between wire and transformer terminal G. Resistance should be 72 (±10.8) ohms.

(7) Connect wire to HV terminal on left windshield transformer.

(8) Disconnect wire from HV terminal on center windshield transformer.

(9) Using ohmmeter check resistance between wire and transformer terminal G. Resistance should be 80 (±12.5) ohms.

(10) Connect wire to HV terminal on center windshield transformer.

(11) Check for current flow in each windshield heating circuit as follows:

NOTE: The duration and frequency of current flow periods depend on the temperature of panel and other variable factors. Current flow period may be as short as 1 second, and if ambient temperature is relatively high, no current may be evident for as long as 20 minutes. Heating systems does not operate at panel temperatures above approximately 100°F (37.8°C).

(a) Apply snap-around type ammeter to one conductor indicated in substep (c) for windshield to be checked.

(b) Close windshield heat circuit breakers corresponding to windshield under test.

(c) Place windshield heat control switch in positions indicated; ammeter readings should be as follows:

Circuit (Circuit Breaker)	Apply ammeter to conductor	Ammeter Reading with switch in		
		OFF	WARM UP	FULL POWER
Left windshield (left outer pane windshield heat)	HV-H702		3.8 to 5.3	6.5 to 9.0
	HV-H733	not more than 1.5	3.8 to 5.3	6.5 to 9.0
Right windshield (right outer pane windshield heat)	HV-H700		3.8 to 5.3	6.5 to 9.0
	HV-H731	not more than 1.5	3.8 to 5.3	6.5 to 9.0
Center windshield (center outer pane windshield heat)	HV-H701		3.4 to 4.8	3.4 to 4.8
	HV-H732	not more than 1.5	3.4 to 4.8	5.8 to 8.1

(d) Place windshield heat control switch in off position.

(e) Open applicable circuit breakers.

(f) Remove ammeter.

(g) Repeat substeps (a through f) for remaining conductor.

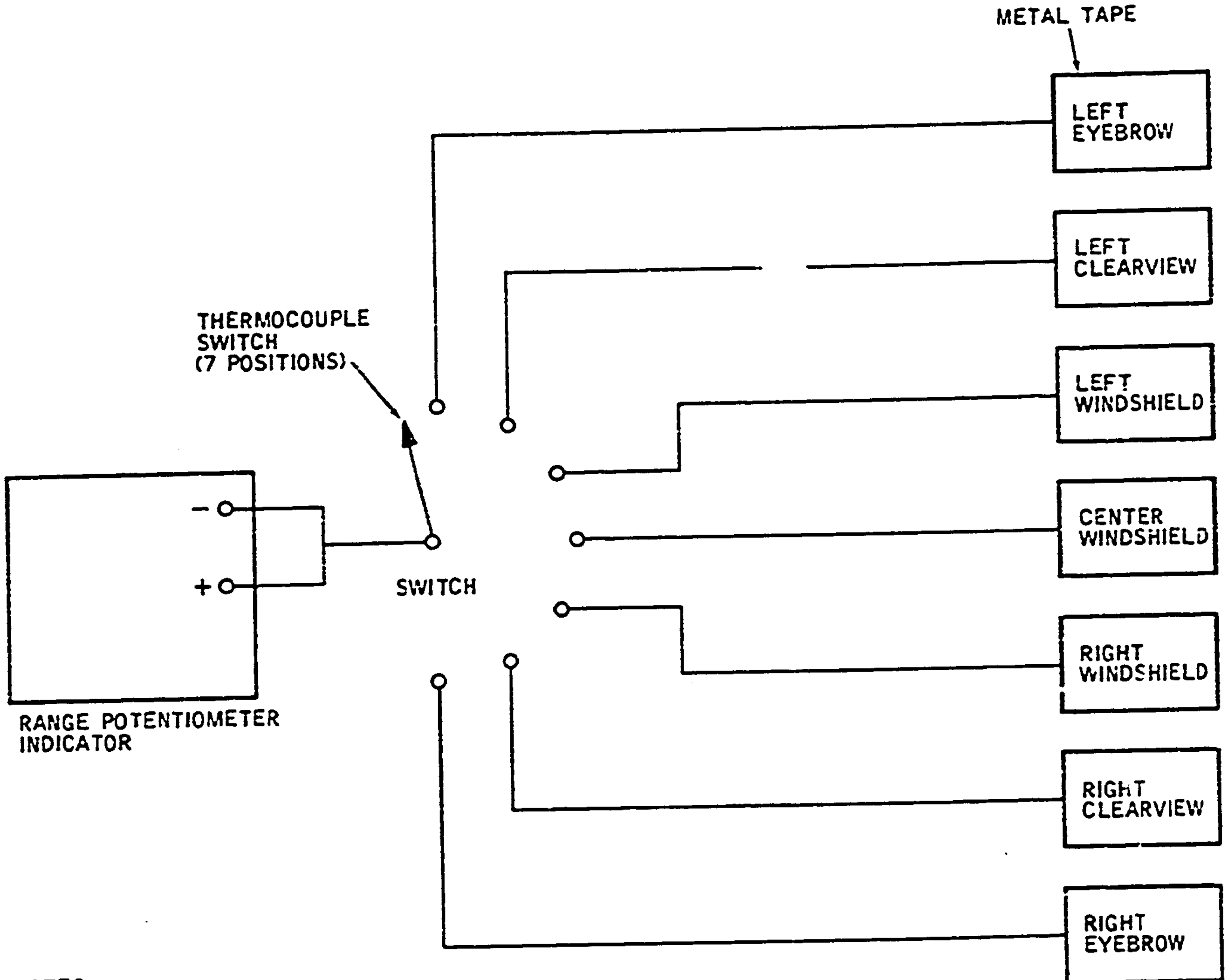
(12) Close window antifogging and windshield heat (right, center, and left) circuit breakers located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

B. Test Windshield Antifogging System

(1) Open windshield heat (right, center, and left) circuit breakers, located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

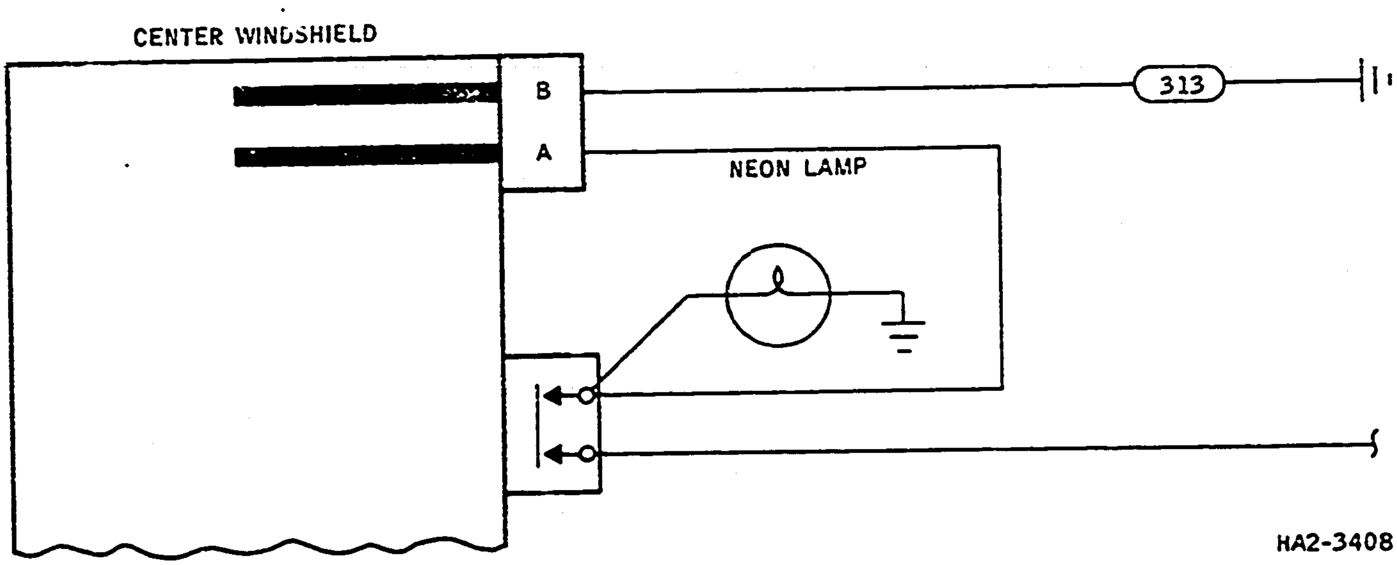
(2) Connect range potentiometer (see Figure 201).

(3) Connect neon lamps (see Figure 201).



NOTES:

1. APPROXIMATELY 1 INCH SQUARE PIECE OF METAL TAPE TO BE USED ON THE INSIDE OF EACH WINDOW.
2. TAPE TO BE LOCATED TOWARD CENTER OF WINDOW WITHIN 1 INCH OF THERMO-SWITCH



Windows and Windshields Antifogging Test Assemblies -- Schematic
Figure 201

(4) Rotate thermocouple switch to each switch position and record ambient temperature in column 1 of recording chart (see Figure 202).

Window	1. Ambient (Temp.)	2. Light Off (Temp.)	3. Light On (Temp.)	4. Light Off Temp. Tolerance	5. Light On Temp. Tolerance
Center Windshield				100°-140°	85°-105°
Right Windshield				100°-140°	85°-105°
Left Windshield				100°-140°	85°-105°
Right Clearview				100°-140°	85°-105°
Left Clearview				100°-140°	85°-105°
Right Eyebrow				100°-140°	85°-105°
Left Eyebrow				100°-140°	85°-105°

Windows and Windshields Antifogging --
Recording Chart
Figure 202

(5) Place windshield heat control switch in warm up position and simultaneously start stop watch. Neon indicator lamps should illuminate.

(6) As each neon lamp extinguishes, turn thermocouple switch to corresponding window and record temperature in column 2 of recording chart. Temperatures should be within tolerances shown in column 4 of recording chart.

CAUTION: IF ANY OF NEON LAMPS HAVE NOT EXTINGUISHED WITHIN 20 MINUTES OR ANY WINDOW TEMPERATURES HAVE RISEN TO 150°F, OPEN WINDOW ANTIFOG CIRCUIT BREAKERS.

(7) After each neon lamp extinguishes, it will again illuminate (within approximately 10 minutes). When lamp illuminates, turn thermocouple switch to corresponding window and record temperature. Temperatures should be within tolerances shown in column 5 of recording chart.

NOTE: If neon indicator lamps are extinguishing and illuminating at to close intervals, close one of window antifog circuit breakers and perform tests on left eyebrow, left clearview and left windshield. Then on right windshield, right clearview, right eyebrow and center windshield.

(8) Place windshield heat control switch in off position.

(9) Disconnect neon lamps.

(10) Disconnect range potentiometer.

(11) Close windshield heat (right, center, and left) circuit breakers, located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

4. Alternate Adjustment/Test Using Dynamic Windshield Temperature - Line Checker

A. Test Windshield

(1) Open windshield over/under temperature, window antifogging, and windshield heat (right, center, and left) circuit breakers, located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

WARNING: OUTPUT VOLTAGES OF WINDSHIELD HAVE A CURRENT RATING THAT IS DANGEROUS TO LIFE.

(2) Connect line checker between applicable windshield controller and airplane wiring.

(3) Connect red clip lead to terminal G of applicable windshield transformer.

(4) Connect black clip lead to structural ground.

(5) Make certain airplane windshield heat selector switch is in off position.

(6) Close applicable windshield heat circuit breakers. Line checker system power light should come on (controller power light may also come on).

CAUTION: REMAINING FOUR WINDSHIELD HEAT CIRCUIT BREAKERS MUST REMAIN OPEN.

(7) Hold checker ambient 110°F +/normal/meter check switch in meter check position, and hold read temperature/normal switch in read temperature position. Windshield temperature meter should read 105 (±5)°F. Release switches.

NOTE: If ambient temperature is 110°F or above, steps (8 through 20) are to be performed with checker ambient 110°F +/normal/meter check switch held in the ambient 110°F + position. Ambient 110°+ switch position alters windshield temperature sensor resistance to value approximately 43 degrees lower than actual temperature, thus at indicated shutoff point of approximately 105°F, actual windshield temperature is approximately 148°F. Checker will now allow panel to rise above safe limit of 180°F.

(8) Hold read temperature/normal switch in read temperature position. Record meter reading.

NOTE: This is "cold" glass temperature and should be within ±20°F to outside ambient temperature.

(9) Return read temperature/normal switch to normal position.

(10) Actuate sense element ground test switch. Grounded light should not come on.

NOTE: Grounded light will come on if element is grounded through any path less than 30,000 ohms. Ground must be cleared before proceeding. Perform steps (11 through 17) quickly and in sequence to complete system analysis before controller shuts off.

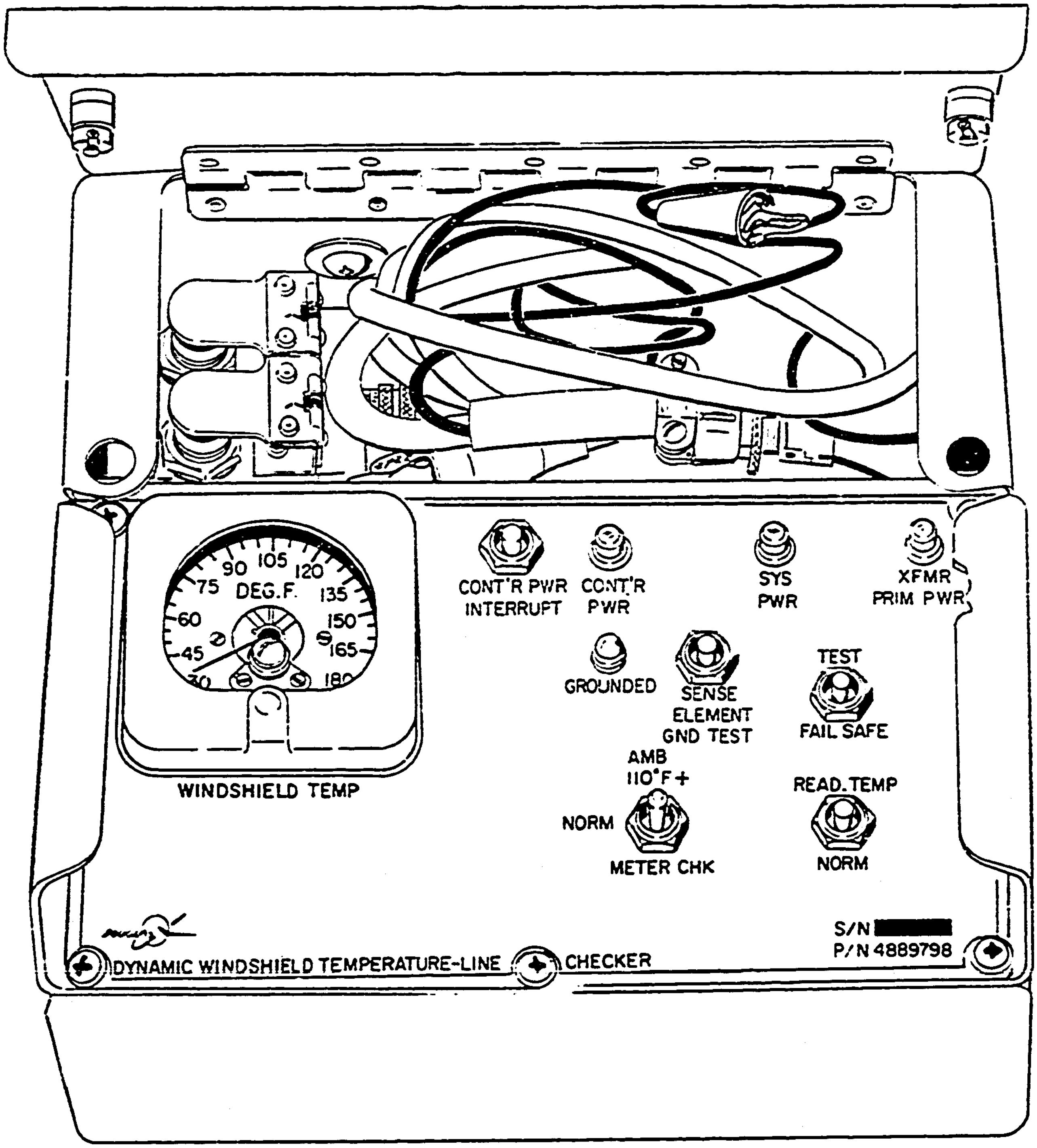
(11) Place windshield heat switch in warm up position. Controller output power and transformer primary power lights, on line checker, should come on.

(12) Place read temperature/normal switch in read temperature position. Controller output power and transformer primary power lights should go off.

(13) Return switch to normal. Controller output power and transformer primary power lights should come on.

(14) Place fail safe switch in test position. Controller output power and transformer primary power lights should go off.

(15) Release fail safe switch to neutral position. Controller output power and transformer primary power lights should come on.



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Dynamic Windshield Temperature -- Line Checker
Figure 203

(16) Approximately ten seconds after controller output power and transformer primary power lights come on, place read temperature/normal switch in read temperature position. Temperature reading should show increase over reading recorded in step (8).

(17) With controller output power and transformer primary power lights on, actuate controller power interrupt switch. Both lights should go off. Release switch.

(18) As windshield continues to heat take frequent temperature readings by placing read temperature/normal switch in read temperature position. Return switch as quickly as possible. Output power and transformer primary power lights should go off when temperature reaches 105(±10)°F.

NOTE: Power is off and windshield is cooling while switch is in read temperature position.

(19) Continue to observe lights. When lights come on take quick temperature reading. Meter should indicate 95(±10)°F.

(20) Repeat steps (11 through 19) with airplane windshield heat switch in full power position.

(21) Place windshield heat switch in off position.

(22) Open applicable windshield heat circuit breakers.

(23) Disconnect line checker.

(24) Close windshield over/under temperature and applicable window antifogging and windshield heat (right, center, and left) circuit breakers.

B. Test Windshield Under/Over Temperature Detector

(1) Open windshield over/under temperature, window antifogging, and windshield heat (right, center, and left) circuit breakers, located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

WARNING: OUTPUT VOLTAGES OF WINDSHIELD HAVE A CURRENT RATING THAT IS DANGEROUS TO LIFE.

(2) Connect line checker between applicable windshield controller and airplane wiring.

(3) Connect red clip lead to terminal G of applicable windshield transformer.

(4) Connect black clip lead to structural ground.

(5) Make certain airplane windshield heat selector switch is in off position.

(6) Close windshield over/under temperature circuit breaker, and windshield heat circuit breakers. Line checker system power light should come on (controller power light may also come on).

CAUTION: REMAINING FOUR WINDSHIELD HEAT CIRCUIT BREAKERS MUST REMAIN OPEN.

(7) Hold checker ambient 110°F +/normal/meter check switch in meter check position, and hold read temperature/normal switch in read temperature position. Windshield temperature meter should read 105(±5)°F. Release switches.

(8) Hold read temperature/normal switch in read temperature position. Record meter reading.

(9) Return read temperature/normal switch to normal position.

(10) Hold ice on outside of windshield, as close to temperature sensor as possible.

CAUTION: DO NOT USE OTHER AGENTS TO LOWER WINDSHIELD TEMPERATURE AS OTHER AGENTS WILL CAUSE TOO SEVERE A TEMPERATURE DROP, CAUSING WINDSHIELD TO CRACK.

(11) Monitor temperature on line checker meter. When temperature drops to 64.5(±15.5)°F, under temperature indicating light should come on.

(12) Remove ice from windshield.

(13) Place windshield heat switch in warm up position and wait approximately five minutes before proceeding with next step.

(14) Increase windshield temperature by holding ambient 110°F+/normal/meter check switch in ambient 110°F+ position.

(15) Monitor increasing temperature by releasing ambient 110°F+/normal/meter check switch and place read temperature/normal switch in read temperature position.

(16) Continue windshield heating by placing read temperature/normal switch in normal position and hold ambient 110°F+/normal/meter check switch in ambient 110°F+ position. When temperature reaches 153(±23)°F over temperature indicating light should come on.

(17) Place windshield heat switch in off position.

(18) Open windshield over/under temperature circuit breaker and windshield heat circuit breakers.

(19) Disconnect line checker.

(20) Close windshield over/under temperature circuit breaker and window antifogging and windshield heat (right, center, and left) circuit breakers.

WINDOWS AND WINDSHIELD ANTI-ICING/ANTIFOGGING - MAINTENANCE PRACTICES

1. General

A. The three windshield panels (left, center, and right), the two eyebrow windows, and the two clearview windows are electrically heated. The heating element coatings are fused between the glass plys and terminal blocks and are provided at the corners of the panels. A defective heating element entails replacement of the glass panel.

B. Each of the three windshields are equipped with two integral temperature-sensing elements. Only one sensing element is used at a time. If one element becomes defective, the airplane wiring may be disconnected at the windshield terminal strip and connected into the standby element circuit.

C. A thermal switch is attached with a spring clip to the inside surface of each of the three windshields, the upper windows, and the two clearview windows. Two terminal screws are provided on each thermal switch for wiring connections.

D. Temperature controllers, one for each windshield, are located on the EPC forward equipment panel.

E. Three transformers, one for each windshield, are located on the EPC forward equipment panel. Six relays, two for each windshield, are located on the EPC forward equipment panel.

F. The antifog relay, one relay for all heated glass panels, is located on the EPC forward equipment panel.

G. Circuit breakers for windshield and window heating are located on the heat, vent, and ice protection bus of the EPC circuit breaker panel.

H. The windshield heat control switch is located on the forward overhead switch panel.

WARNING: OUTPUT VOLTAGES OF WINDSHIELD TRANSFORMERS HAVE A CURRENT RATING THAT IS DANGEROUS TO LIFE.

I. An alternate method of adjustment test is provided, using the Douglas dynamic windshield temperature - line checker. Adjustment/test procedures using the line checker for the left, center, and right windshields are identical.

J. When a windshield panel (left, center or right) is changed because of overheating (bubbling), the following components, associated with the panel being replaced, are to be changed.

(1) Controller, temperature windshield anti-ice.

(2) Relay, multiple use 115V A.C. high heat power.

(3) Relay multiple use 115V A.C. low heat power.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Multiple range potentiometer indicator		Leeds & Northrup Co.	Test windshield antifogging system
B	Thermocouple Switch (7 position)			Test windshield antifogging system
C	Thermocouple Wire			Test windshield antifogging system
D	Metal tape		Mystik	Test windshield antifogging system
E	Neon Lamp (7 required)	NE-51H		Test windshield antifogging system
F	Multimeter	630A	Triplett	Test windshield antifogging system
G	Stopwatch			Test windshield antifogging system
H	Ohmmeter. (0-200 ohm range)			Test windshield anti-icing system

Item	Name	Number	Manufacturer	Use
J	Ammeter, snap around type (0-10 amperes, 125 to 250 volt range)			Test windshield anti-icing system
K	Dynamic wind-shield tempera-ture-line checker	4889798	Douglas Aircraft Co., Inc.	Test windshield anti-icing system

3. Adjustment/Test Windshield and Windows Anti-Icing/Antifogging System

NOTE: In order to accurately determine system operation, ambient temperature of the window and windshield panels should be below approximately 80°F (26.7°C) at start of the trouble shooting procedures. It is recommended that the procedures be conducted inside a hanger or in a shaded area.

A. Test Windshield Anti-Icing System

(1) Open window antifogging and windshield heat (right, center, and left) circuit breakers, located on heat, vent and ice protection (ac bus) section of circuit breaker panel.

WARNING: OUTPUT VOLTAGES OF WINDSHIELD TRANSFORMERS HAVE A CURRENT RATING THAT IS DANGEROUS TO LIFE.

(2) Disconnect wire from HV terminal on right windshield transformer.

(3) Using ohmmeter check resistance between wire and transformer terminal G. Resistance should be 72 (±10.8) ohms.

(4) Connect wire to HV terminal on right windshield transformer.

(5) Disconnect wire from HV terminal on left windshield transformer.

(6) Using ohmmeter check resistance between wire and transformer terminal G. Resistance should be 72 (±10.8) ohms.

(7) Connect wire to HV terminal on left windshield transformer.

(8) Disconnect wire from HV terminal on center windshield transformer.

(9) Using ohmmeter check resistance between wire and transformer terminal G. Resistance should be 80 (±12.5) ohms.

(10) Connect wire to HV terminal on center windshield transformer.

(11) Check for current flow in each windshield heating circuit as follows:

NOTE: The duration and frequency of current flow periods depend on the temperature of panel and other variable factors. Current flow period may be as short as 1 second, and if ambient temperature is relatively high, no current may be evident for as long as 20 minutes. Heating system does not operate at panel temperatures above approximately 100°F (37.8°C).

(a) Apply snap-around type ammeter to one conductor indicated in Substep (c) for windshield to be checked.

(b) Close windshield heat circuit breakers corresponding to windshield under test.

(c) Place windshield heat control switch in positions indicated; ammeter readings should be as follows:

Circuit (Circuit Breaker)	Apply ammeter to conductor	Ammeter Reading with switch in		
		OFF	WARM UP	FULL POWER
Left windshield (left outer pane windshield heat)	HV-H702	Not more than 1.5	3.8 to 5.3	6.5 to 9.0
	HV-H733		3.8 to 5.3	6.5 to 9.0
Right windshield (right outer pane windshield heat)	HV-H700	Not more than 1.5	3.8 to 5.3	6.5 to 9.0
	HV-H731		3.8 to 5.3	3.8 to 5.3
Center windshield (center outer pane windshield heat)	HV-H701	Not more than 1.5	3.4 to 4.8	5.8 to 8.1
	HV-H732		3.4 to 4.8	5.8 to 8.1

(d) Place windshield heat control switch in off position.

(e) Open applicable circuit breakers.

(f) Remove ammeter.

(g) Repeat substeps (a through f) for remaining conductor.

(12) Close window antifogging and windshield heat (right, center, and left) circuit breakers located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

B. Test Windshield Antifogging System

(1) Open windshield heat (right, center, and left) circuit breakers, located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

(2) Connect range potentiometer (see Figure 201).

(3) Connect neon lamps (see Figure 201).

(4) Rotate thermocouple switch to each switch position and record ambient temperature in column 1 of recording chart (see Figure 202).

(5) Place windshield heat control switch in warm up position and simultaneously start stop watch. Neon indicator lamps should illuminate.

(6) As each neon lamp extinguishes, turn thermocouple switch to corresponding window and record temperature in column 2 of recording chart. Temperatures should be within tolerances shown in column 4 of recording chart.

<u>CAUTION</u>: IF ANY OF NEON LAMPS HAVE NOT EXTINGUISHED WITHIN 20 MINUTES OR ANY WINDOW TEMPERATURES HAVE RISEN TO 150°F, OPEN WINDOW ANTIFOG CIRCUIT BREAKERS.

(7) After each neon lamp extinguishes, it will again illuminate (within approximately [illegible] minutes). When lamp illuminates, turn thermocouple switch to corresponding window and record temperature. Temperatures should be within tolerances shown in column 5 of recording chart.

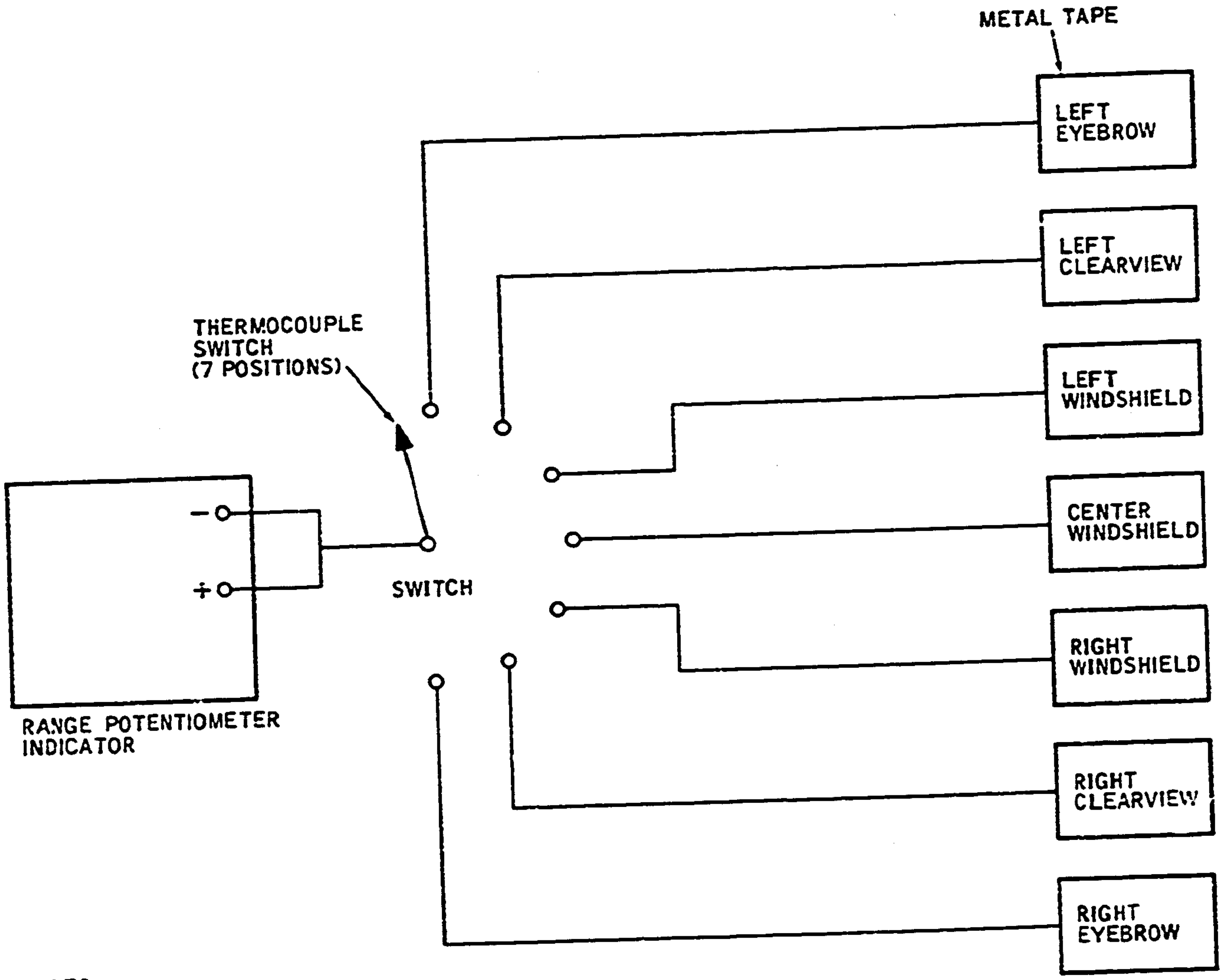
<u>NOTE</u>: If neon indicator lamps are extinguishing and illuminating at to close intervals, close one of window antifog circuit breakers and perform tests on left eyebrow, left clearview and left windshield. Then on right windshield, right clearview, right eyebrow and center windshield.

(8) Place windshield heat control switch in off position.

(9) Disconnect neon lamps.

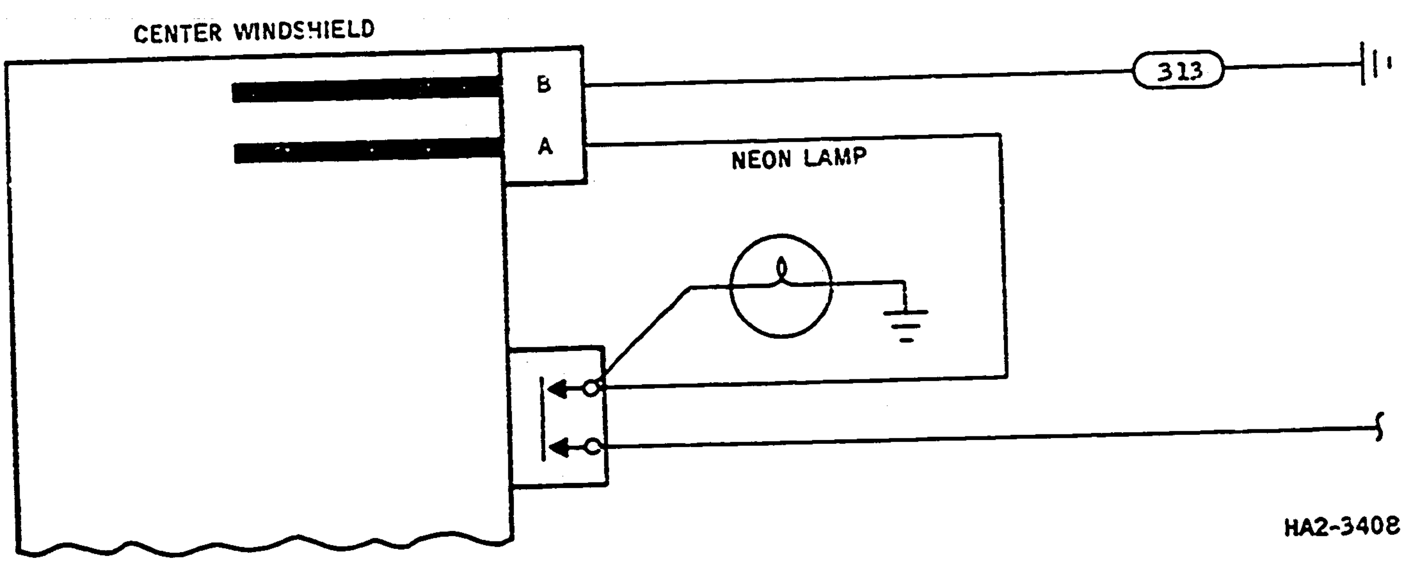
(10) Disconnect range potentiometer.

(11) Close windshield heat (right, center, and left) circuit breakers, located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.



NOTES:

1. APPROXIMATELY 1 INCH SQUARE PIECE OF METAL TAPE TO BE USED ON THE INSIDE OF EACH WINDOW.
2. TAPE TO BE LOCATED TOWARD CENTER OF WINDOW WITHIN 1 INCH OF THERMO-SWITCH



HA2-3408

Windows and Windshields Antifogging Test Assemblies -- Schematic
Figure 201

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Window	1. Ambient (Temp.)	2. Light Off (Temp.)	3. Light On (Temp.)	4. Light Off Temp. Tolerance	5. Light On Temp. Tolerance
Center Windshield				100° -140°	85° -105°
Right Windshield				100° -140°	85° -105°
Left Windshield				100° -140°	85° -105°
Right Clearview				100° -140°	85° -105°
Left Clearview				100° -140°	85° -105°
Right Eyebrow				100° -140°	85° -105°
Left Eyebrow				100° -140°	85° -105°

Windows and Windshields Antifogging --
Recording Chart
Figure 202

4. Alternate Adjustment/Test Using Dynamic Windshield Temperature - Line Checker

A. Test Windshield

(1) Open window antifogging and windshield heat (right, center, and left) circuit breakers, located on heat, vent, and ice protection (ac bus) section of circuit breaker panel.

WARNING: OUTPUT VOLTAGES OF WINDSHIELD HAVE A CURRENT RATING THAT IS DANGEROUS TO LIFE.

(2) Connect line checker between applicable windshield controller and airplane wiring.

(3) Connect red clip lead to terminal G of applicable windshield transformer.

(4) Connect black clip lead to structural ground.

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(5) Make certain airplane windshield heat selector switch is in off position.

(6) Close applicable windshield heat circuit breakers. Line checker system power light should come on (controller power light may also come on).

<u>CAUTION</u>: REMAINING FOUR WINDSHIELD HEAT CIRCUIT BREAKERS MUST REMAIN OPEN.

(7) Hold checker ambient 110°F +/normal/meter check switch in meter check position, and hold read temperature/normal switch in read temperature position. Windshield temperature meter should read 105 (±5)°F. Release switches.

<u>NOTE</u>: If ambient temperature is 110°F or above, Steps (8 through 20) are to be performed with checker ambient 110°F +/normal/meter check switch held in the ambient 110°F + position. Ambient 110°+ switch position alters windshield temperature sensor resistance to value approximately 43 degrees lower than actual temperature, thus at indicated shutoff point of approximately 105°F, actual windshield temperature is approximately 148°F. Checker will not allow temperature of windshield panel to rise above safe limit of 180°F.

(8) Hold read temperature /normal switch in read temperature position. Record meter reading.

<u>NOTE</u>: This is "cold" glass temperature and should be within ±20°F to outside ambient temperature.

(9) Return read temperature/normal switch to normal position.

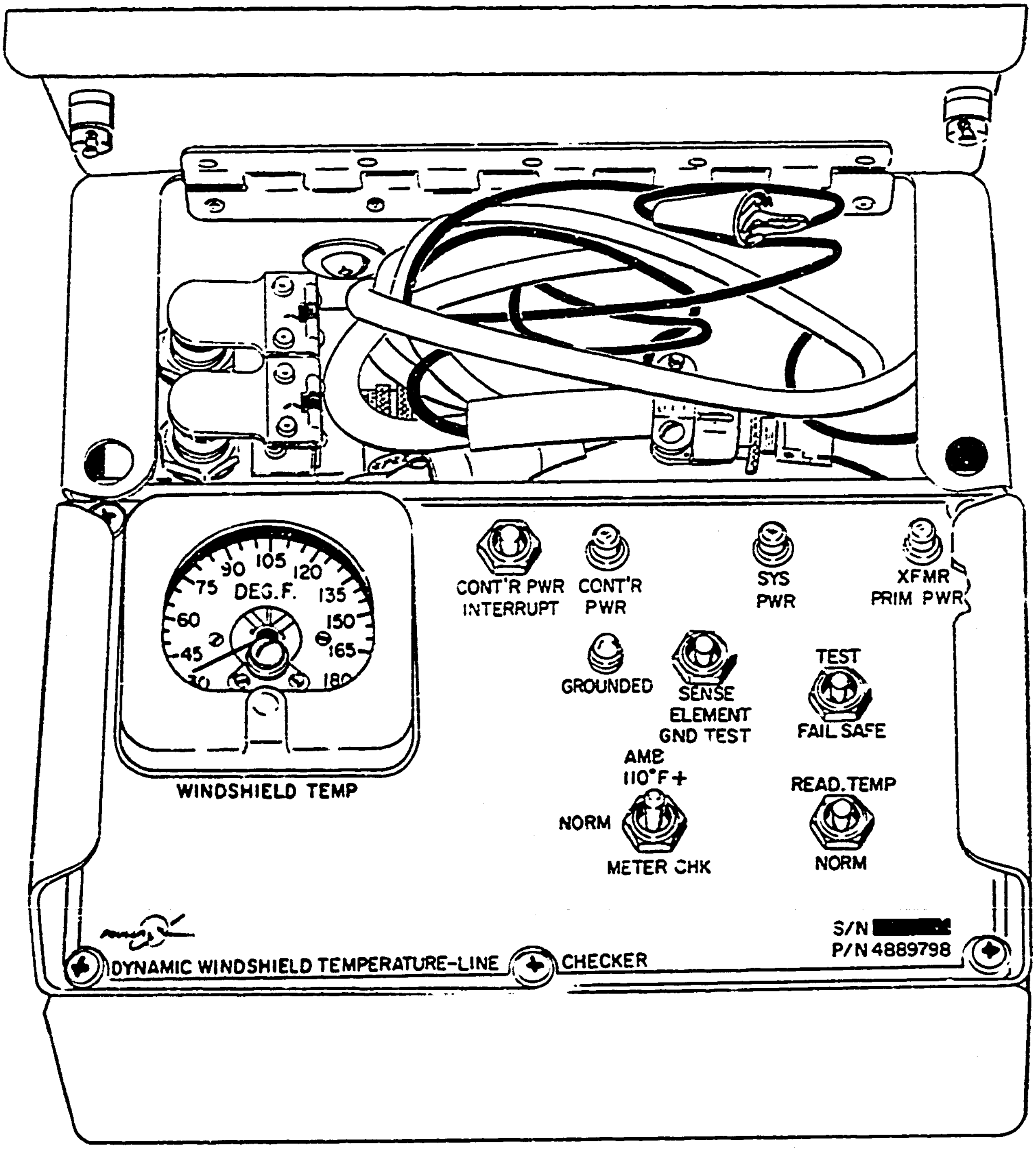
(10) Actuate sense element ground test switch. Grounded light should not come on.

<u>NOTE</u>: Grounded light will come on if element is grounded through any path less than 30,000 ohms. Ground must be cleared before proceeding. Perform Steps (11 through 17) quickly and in sequence to complete system analysis before controller shuts off.

(11) Place windshield heat switch in warm up position. Controller output power and transformer primary power lights, on line checker, should come on.

(12) Place read temperature/normal switch in read temperature position. Controller output power and transformer primary power lights should go off.

(13) Return switch to normal. Controller output power and transformer primary power lights should come on.



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Dynamic Windshield Temperature -- Line Checker
Figure 203

(14) Place fail safe switch in test position. Controller output power and transformer primary power lights should go off.

(15) Release fail safe switch to neutral position. Controller output power and transformer primary power lights should come on.

(16) Approximately ten seconds after controller output and transformer primary power lights come on, place read temperature/normal switch in read temperature position. Temperature reading should show increase over reading recorded in Step (8).

(17) With controller output power and transformer primary power lights on, actuate controller power interrupt switch. Both lights should go off. Release switch.

(18) As windshield continues to heat take frequent temperature readings by placing read temperature/normal switch in read temperature position. Return switch as quickly as possible. Output power and transformer primary power lights should go off when meter indicator reaches 105 (±10)°F.

NOTE: Power is off and windshield is cooling while switch is in read temperature position.

(19) Continue to observe lights. When lights come on take quick temperature reading. Meter should indicate 95 (±10)°F.

(20) Repeat Steps (11 through 19) with airplane windshield heat switch in full power position.

(21) Place windshield heat switch in off position.

(22) Open applicable windshield heat circuit breakers.

(23) Disconnect line checker.

(24) Close window antifogging and windshield heat (right, center, and left) circuit breakers.

WINDSHIELD AND WINDOW TEMPERATURE CONTROL

AMPLIFIERS - MAINTENANCE PRACTICES

1. General

   A. The windshield and window temperature control amplifiers are located in the EPC forward equipment panel. Access to the components is through access door 623.

   B. The Removal/Installation procedures for all windshield and all window temperature control amplifiers are identical except as noted.

2. Removal/Installation Windshield and Window Temperature Control Amplifiers

   A. Remove Windshield Temperature Control Amplifier

      (1) Open applicable outer pane windshield heat circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

      (2) Disconnect electrical connector from applicable windshield temperature control amplifier.

      (3) Remove amplifier.

   B. Install Windshield Temperature Control Amplifier

      (1) Make certain that applicable outer pane windshield heat circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel, is open.

      (2) Position amplifier on EPC forward equipment panel and install amplifier.

      (3) Connect electrical connector to amplifier.

      (4) Close applicable outer pane windshield heat circuit breaker.

   C. Remove Eyebrow or Clearview Window Temperature Control Amplifier

      (1) Open eyebrow and clearview window heat circuit breaker,located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

      (2) Disconnect electrical connector from applicable eyebrow or clearview window temperature control amplifier.

      (3) Remove amplifier.

D. Install Eyebrow or Clearview Window Temperature Control Amplifier

(1) Make certain that eyebrow and window heat circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel, is open.

(2) Position eyebrow or clearview window temperature control amplifier on EPC forward equipment panel and install amplifier.

(3) Connect electrical connector to amplifier.

(4) Close eyebrow and clearview window heat circuit breaker.

3. Adjustment/Test Windshield and Window Temperature Control Amplifier

A. The windshield and window temperature control amplifiers are tested in 30-41-C.

WINDSHIELD HEAT TRANSFORMERS - MAINTENANCE PRACTICES

1. General

A. The windshield heat transformers, one for each windshield, are located on the forward equipment panel of the electrical power center.

B. Removal and installation procedures for all three transformers are identical except where noted otherwise.

2. Tools and Equipment Required

A. A multimeter (Simpson Model 260, or equivalent) is required for windshield resistance test prior to connection of transformer.

3. Removal/Installation Windshield Heat Transformers

A. Remove Transformer

(1) Open applicable outer pane windshield heat circuit breaker, located on heat, vent, and ice protection ac bus section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKERS.

(2) Tag and disconnect electrical wires from transformer.

(3) Remove transformer from forward equipment panel.

B. Install Transformer

(1) Make certain that outer pane windshield heat circuit breaker is open.

(2) Install transformer on forward equipment panel.

(3) Connect all electrical wires to transformer except wire to lettered terminal.

(4) Using multimeter, check resistance between transformer terminal 1 and electrical wire left disconnected in step (3). On side windshields, resistance should be 81.6 ohms or more; on center windshield, resistance should be 96 ohms or more.

(5) Depending on type of transformer and value obtained in step (4), connect remaining electrical wire to transformer lettered terminal as follows:

Transformer Type	Side Windshield-Resistance in ohms	Transformer Terminal	Center Windshield-Resistance in ohms
3-lettered terminals	81.6 to 125.0	X	96.0 to 120.0
		Y	120.1 to 140.0
5-lettered terminals	81.6 to 92.0	V	
	92.1 to 103.5	W	96.0 to 114.0
	103.6 to 125.0	X	114.1 to 140.0

(6) Close outer pane windshield heat circuit breaker.

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WINDSHIELD PNEUMATIC RAIN REMOVAL SYSTEM - DESCRIPTION AND OPERATION

1. General

A. Description

(1) The windshield pneumatic rain removal system uses hot air from the pneumatic system to divert rain from the left and right windshields during flight. Air is supplied to the left windshield from the left pneumatic rain removal duct and to the right windshield from the right pneumatic rain removal duct. Both rain removal ducts receive air from the airplane pneumatic manifold. A cable-operated shutoff valve is installed in each rain removal duct. The air is directed upward through an external slotted nozzle at the base of the windshield with enough velocity to keep the windshield clear. The system is manually operated by a lever located on each pilot's console. The lever operates a cable system that opens the shutoff valve and allows air from the low-pressure pneumatic system to flow through the valve to the rain removal nozzles and over the windshield. The pattern of airflow depends on the forward movement of the airplane.

CAUTION: RAIN REMOVAL CONTROL LEVERS MUST BE IN OFF POSITION WHEN SYSTEM IS NOT IN USE. IF LEVERS ARE LEFT IN ON POSITION, RAIN OR CONDENSATION MIGHT ENTER CABIN COMPRESSORS AND CAUSE DAMAGE TO COMPRESSORS, WHEN STARTED.

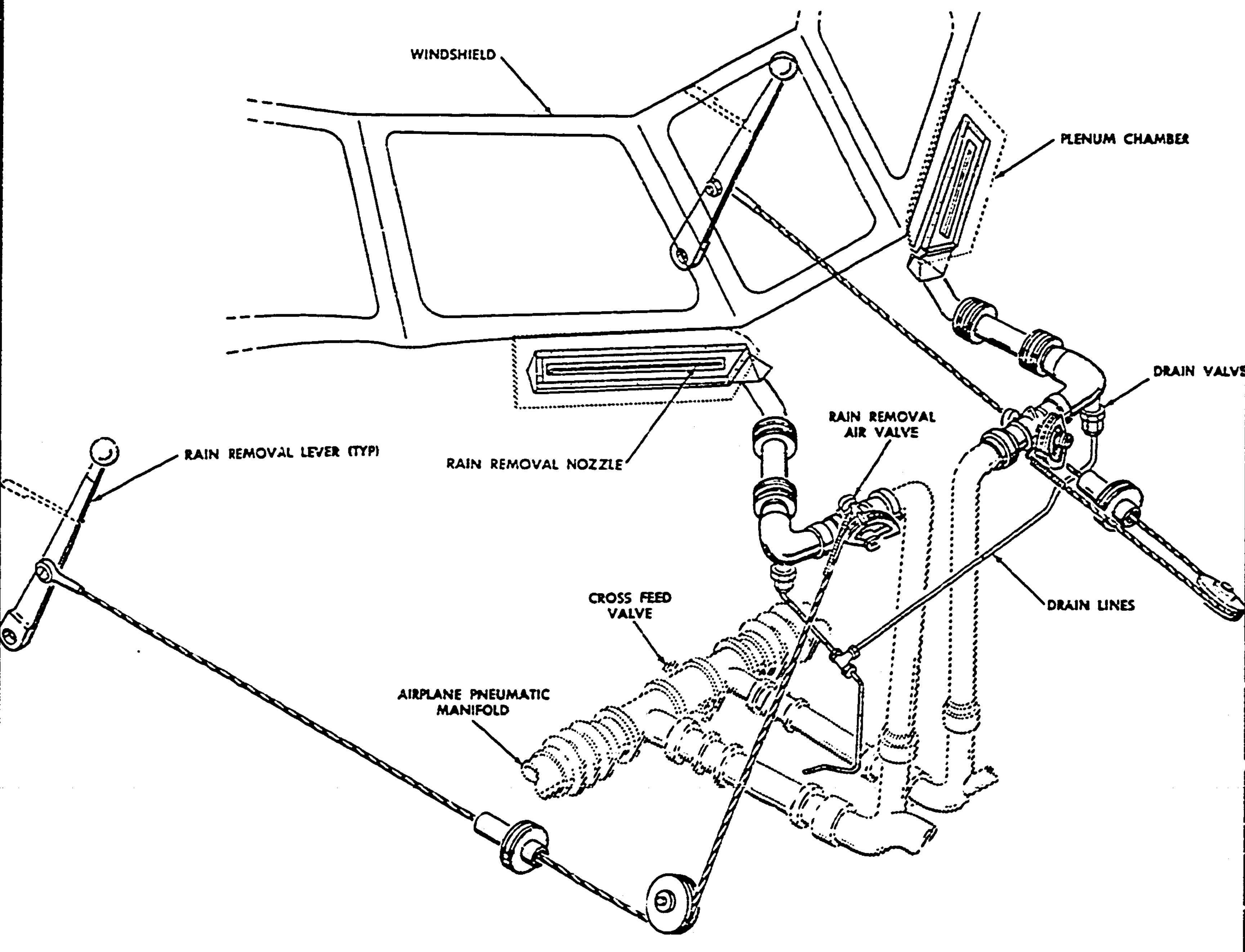
2. System Components

A. Shutoff Valves

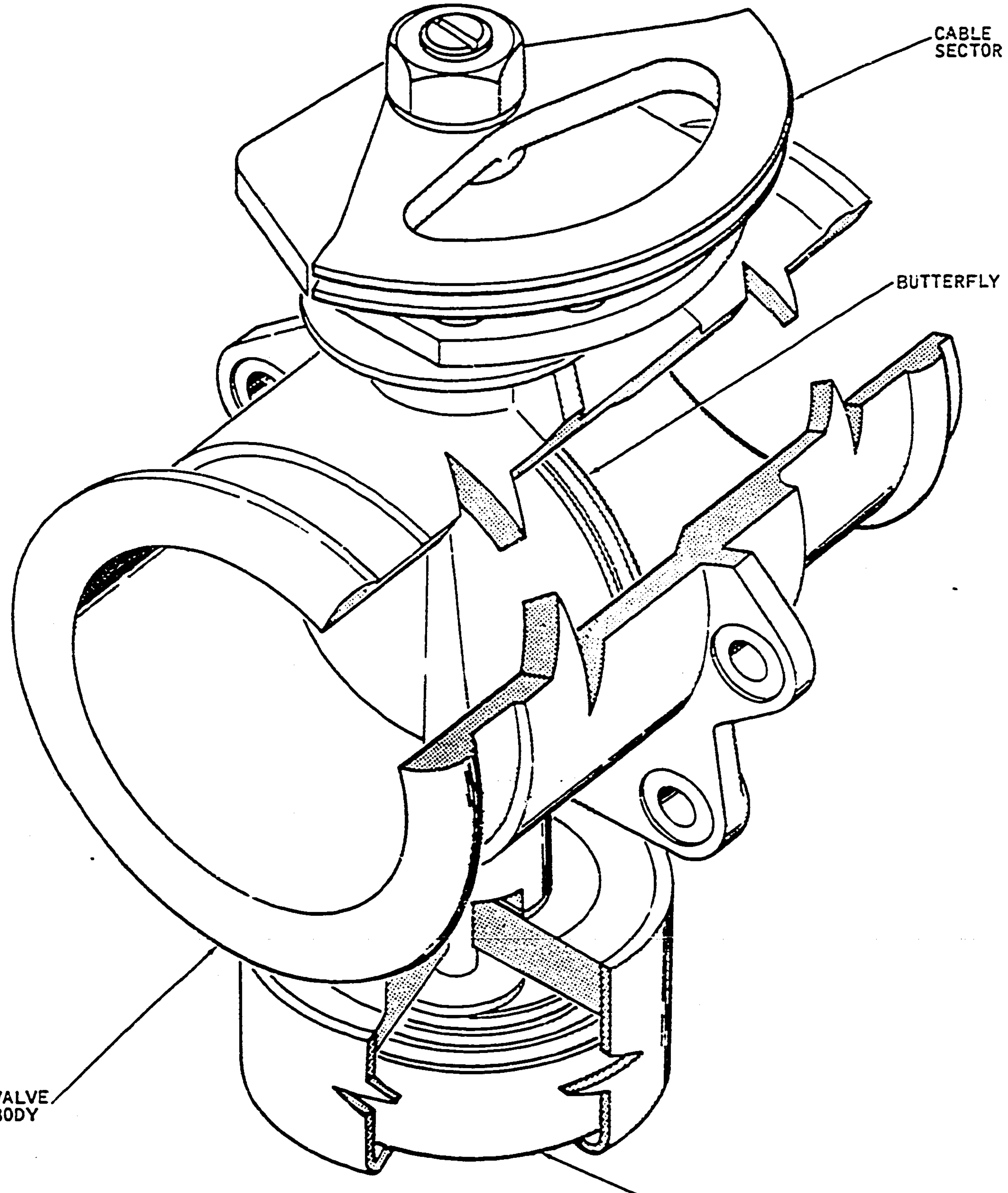
(1) The windshield pneumatic rain removal shutoff valves are installed in the fuselage nose section between the rain removal ducts and the plenum chambers. There are two shutoff valves, one for the left windshield and one for the right windshield.

(2) Each valve is actuated through a single cable by a lever mounted on the corresponding pilot's console. Operation of each valve is independent of the other valve. When the valve is opened, hot air is directed to the rain removal nozzles.

(3) Movement of the lever on either console to the open position operates the respective shutoff valve to the open position. The positive position stop on the cam, splined to the butterfly shaft, positions the valve to the open position. The action of the shaft also winds the spiral spring tighter, allowing the valve to go to the closed position when the lever is moved to the closed position. The single cable positions the valve to the open position and the spring closes the valve. The valve will go to the closed position and will remain closed, if the cable should brake.



Windshield Pneumatic Rain Removal -- Functional
Figure 1



Windshield Pneumatic Rain Removal
Shutoff Valve -- Schematic
Figure 2

B. Pneumatic Nozzles

(1) The pneumatic rain removal nozzles are located forward of the left and right windshield outer panels. The nozzles are attached to the fuselage nose section plating that forms the access door to the plenum chambers. Air from the low-pressure pneumatic system flows through the rain removal shutoff valves and into the plenum chamber. The nozzles are fixed slots forming an air outlet from the plenum chambers. The nozzles direct the airflow over the windshields at an angle of 6 degrees from the surface of the glass. The small angle prevents overheating of the windshield panels when there is no forward movement of the airplane; however, extended or unnecessary operation of the pneumatic rain removal system on the ground should be avoided.

C. Drain Valves

(1) A drain valve is located on the downstream side of each windshield rain removal shutoff valve to provide for the removal of water that might enter the system. These valves are spring loaded to the open position; but, when the pressure in the pneumatic duct builds up to 4 (±2 1/2) psig, the valves close. The air then flows freely to the windshield. When the pressure in the duct is removed (valve closed), the load action of the spring c ns the valve.

WINDSHIELD PNEUMATIC RAIN REMOVAL SYSTEM -

MAINTENANCE PRACTICES

1. General

   A. Access to the windshield pneumatic rain removal system is through the flight compartment and through two access doors located on the upper surface of the nose section.

   B. The numbers and letters enclosed in the hexagonal symbols in Figure 201 correspond to the cable run numbers and segment letters listed at the end of this section. Each cable run number is posted adjacent to the corresponding cable in the airplane.

   C. The adjustment procedures for the mechanical controls of the left and right windshield pneumatic rain removal systems are identical.

2. Adjustment/Test Windshield Pneumatic Rain Removal System

   A. Adjust Windshield Pneumatic Rain Removal System

      (1) Check that slot in end of windshield pneumatic rain removal shutoff valve shaft is aligned with cable guard pin.

         NOTE: Valve is spring loaded and is in closed position.

      (2) Adjust turnbuckle, located aft of pressure seal in flight compartment, so that there is slight amount of slack in cable between tension spring attaching point and sector.

      (3) Operate rain removal lever through full travel several times.

         NOTE: Swaged tube on cable must extend at least 3/4 inch from pressure seal when in full on or full off position.

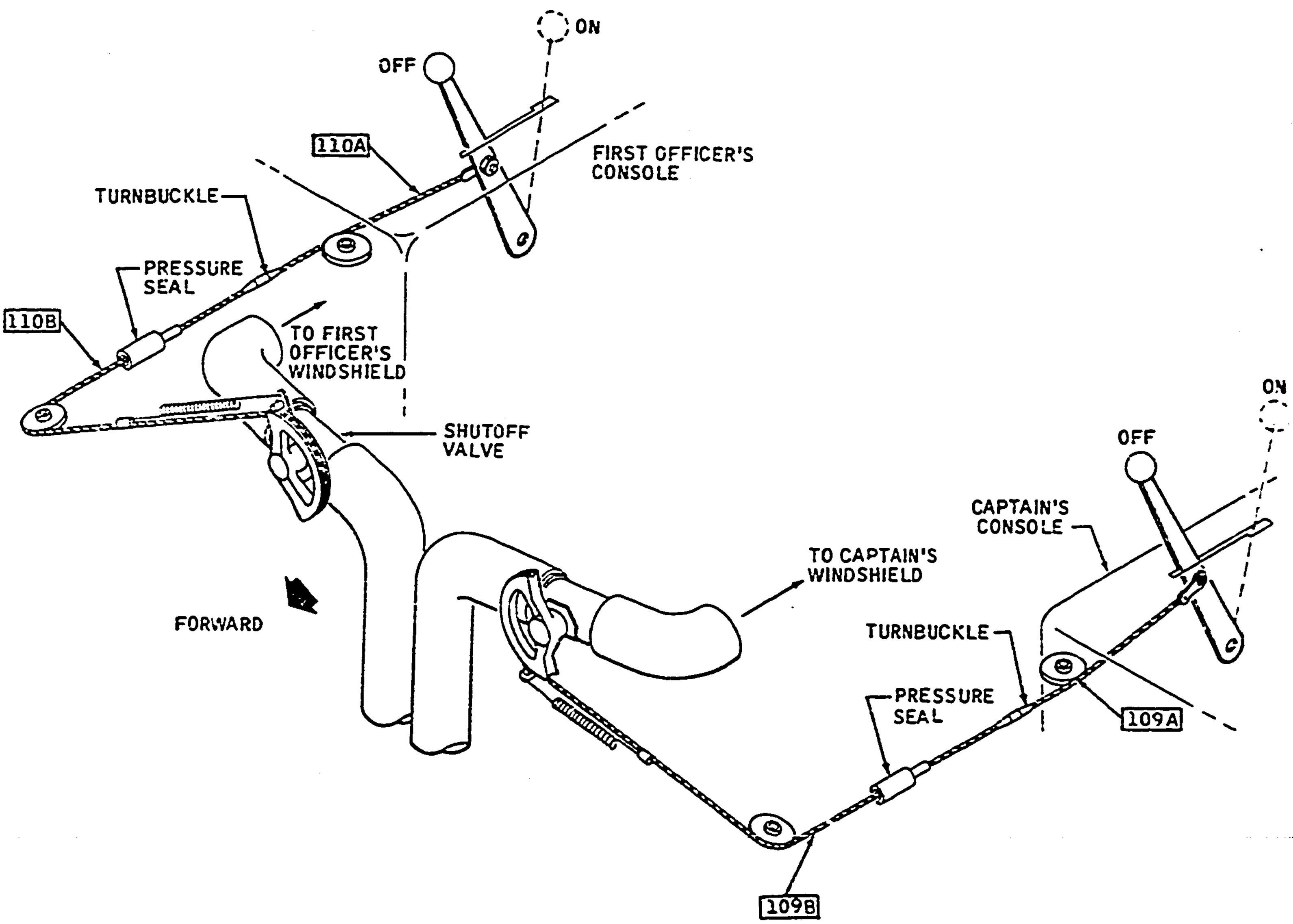
      (4) Place rain removal lever in on position. Check that slot in end of shutoff valve shaft is aligned with centerline of duct.

      (5) Place rain removal lever in off position. Check that slot in end of shutoff valve shaft is aligned with cable guard pin and that there is slight amount of slack in cable between tension spring attaching point and sector.

      (6) Safety turnbuckle with lockwire.

   B. Test Windshield Pneumatic Rain Removal System

      (1) Check that windshield rain removal levers are in off position.



Windshield Air Rain Removal Mechanical Control
System -- Adjustment Diagram
Figure 201

(2) Connect external pneumatic source, and pneumatic manifold (see Chapter 36).

(3) Place left rain removal lever in on position, and check that air flows over left windshield.

CAUTION: DO NOT OPERATE WINDSHIELD PNEUMATIC RAIN REMOVAL SYSTEM WITH AIR FROM EXTERNAL PNEUMATIC SOURCE ABOVE 200°F (93.3°C). DO NOT OPERATE SYSTEM WITH ENGINE BLEED AIR FOR LONGER THAN 10 SECONDS ON A DRY WINDSHIELD.

(4) Place left rain removal lever in off position, and check that airflow over left windshield stops.

(5) Place right rain removal lever in on position, and check that air flows over right windshield.

(6) Place right rain removal lever in off position, and check that airflow over right windshield stops.

CAUTION: RAIN REMOVAL CONTROL LEVERS MUST BE IN OFF POSITION WHEN SYSTEM IS NOT IN USE. IF LEVERS ARE LEFT IN ON POSITION, RAIN OR CONDENSATION MIGHT ENTER CABIN COMPRESSORS THROUGH RAIN REMOVAL SHUTOFF VALVES AND CAUSE DAMAGE TO COMPRESSORS, WHEN STARTED.

(7) Depressurize pneumatic manifold, and disconnect external pneumatic source (see Chapter 36).

C. Cable Asse blies

NOTE: The cable run numbers and the segment letters in the following chart correspond to the callouts in Figure 201.

Function	Cable Run Number	Segment Letter
Left windshield pneumatic rain removal system control	109	A B
Right windshield pneumatic rain removal system control	110	A B

WINDSHIELD PNEUMATIC RAIN REMOVAL SHUTOFF VALVES - MAINTENANCE PRACTICES

1. General

A. The removal and installation procedures for the left and the right windshield pneumatic rain removal shutoff valves are identical.

B. Access to the shutoff valves is through access doors located on the upper surfaces of the nose.

2. Removal/Installation Windshield Pneumatic Rain Removal Shutoff Valves

A. Remove Shutoff Valve

(1) Release control cable tension spring from spring attaching point, and disconnect cable from windshield pneumatic rain removal shutoff valve sector.

(2) Loosen clamps that connect valve to rain removal duct and to plenum chamber duct.

(3) Remove valve from airplane.

B. Install Shutoff Valve

(1) Install windshield pneumatic rain removal shutoff valve in position between plenum chamber duct and rain removal duct.

NOTE: The slot in the end of the valve shaft must be aligned with the centerline of the rain removal duct.

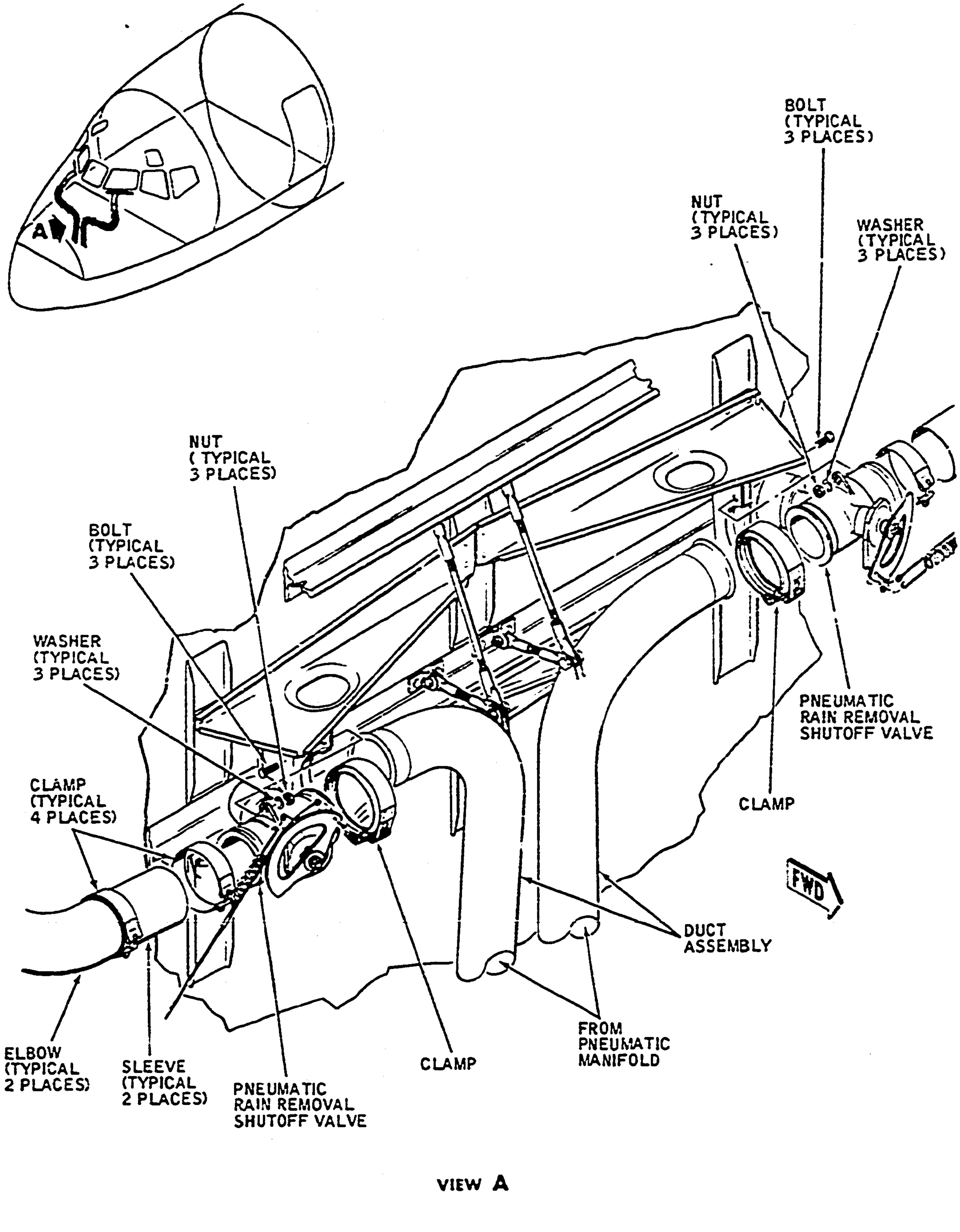
(2) Connect valve to rain removal duct and plenum chamber duct with clamps.

(3) Tighten rain removal duct clamp to torque of 45 (±5) inch-pounds.

(4) Tighten plenum chamber duct clamp to torque of 30 to 50 inch-pounds.

(5) Connect control cable to valve sector, and attach control cable tension spring.

NOTE: The cast arrow on the sector must be aligned with the cable guard pin.



Windshield Pneumatic Rain Removal
Shutoff Valves -- Installation
Figure 201

3. Adjustment/Test Windshield Pneumatic Rain Removal Shutoff Valves

A. Test shutoff Valve

(1) Pressurize pneumatic manifold from pneumatic ground source (see Chapter 36).

CAUTION: AIR FROM GROUND PNEUMATIC SOURCE MUST BE UNDER 200°F (93.3°C).

(2) Make certain rain removal control lever is in off position.

(3) Check that there is no flow from corresponding plenum chamber.

(4) Place rain removal control lever in on position.

(5) Check that there is airflow from corresponding plenum chamber.

(6) Place rain removal control lever in off position.

(7) Depressurize pneumatic manifold and disconnect pneumatic ground source (see Chapter 36).

WINDSHIELD PNEUMATIC RAIN REMOVAL PLENUM CHAMBERS - MAINTENANCE PRACTICES

1. General

   A. The removal and installation procedures for the left and right windshield pneumatic rain removal plenum chambers are identical.

   B. Access to the plenum chamber duct connections is through the flight compartment, forward of the pilots' instrument panels.

   C. Access to removal of the plenum chambers is from outside of the fuselage nose.

2. Tools and Equipment Required

   NOTE: Equivalent substitutes may be used instead of the following listed items:

Item	Name	Number	Manufacturer	Use
A	Sealant base	RTV-1016	General Electric Co. Silicone Products Dept.	Seal faying surfaces of rain removal plenum chambers.
B	Sealant catalyst	RTV-9910	General Electric Co. Silicone Products Dept.	Seal faying surfaces of rain removal plenum chambers.
C	Methyl-ethyl-ketone (MEK)	TT-M-00261	Local	Cleaning surfaces.

   NOTE: Sealant should be mixed immediately prior to use and is mixed 100 parts base to 10 parts of catalyst (by weight).

3. Removal/Installation Windshield Pneumatic Rain Removal Plenum Chambers

   A. Remove Plenum Chamber

      (1) Disconnect pneumatic rain removal supply duct from windshield pneumatic rain removal plenum chamber. Discard O-ring.

      (2) From outside fuselage nose, remove plenum chamber.

B. Install Plenum Chamber

(1) Remove sealant from faying surfaces of plenum chamber and duct.

(2) Apply fresh sealant to faying surfaces (see Chapter 20) and install plenum chamber.

(3) Using new O-ring, connect pneumatic rain removal supply duct to plenum chamber.

WINDSHIELD PNEUMATIC RAIN REMOVAL CONTROL LEVERS -

MAINTENANCE PRACTICES

1. General

   A. The removal and installation procedures for the left and the right windshield pneumatic rain removal control levers are identical.

   B. Access for removal of the control levers is through an access door located on the left and right pilots' console in the flight compartment.

2. Removal/Installation Windshield Pneumatic Rain Removal Control Levers

   A. Remove Control Levers

      (1) Remove knob and spacers from rain removal control lever.

      (2) Disconnect windshield rain removal shutoff valve control cable at fork attached to control lever.

      (3) Remove lever attaching bolt and shim washers from lever support bracket.

         NOTE: To aid in proper installation of the lever, record the number of shim washers on each side of the lever when removing the attaching bolt.

      (4) Draw lever downward through lever guide and remove from console.

   B. Install Control Lever

      (1) Insert rain removal control lever through lever guide.

      (2) Install lever on support bracket with attaching bolt and shim washers.

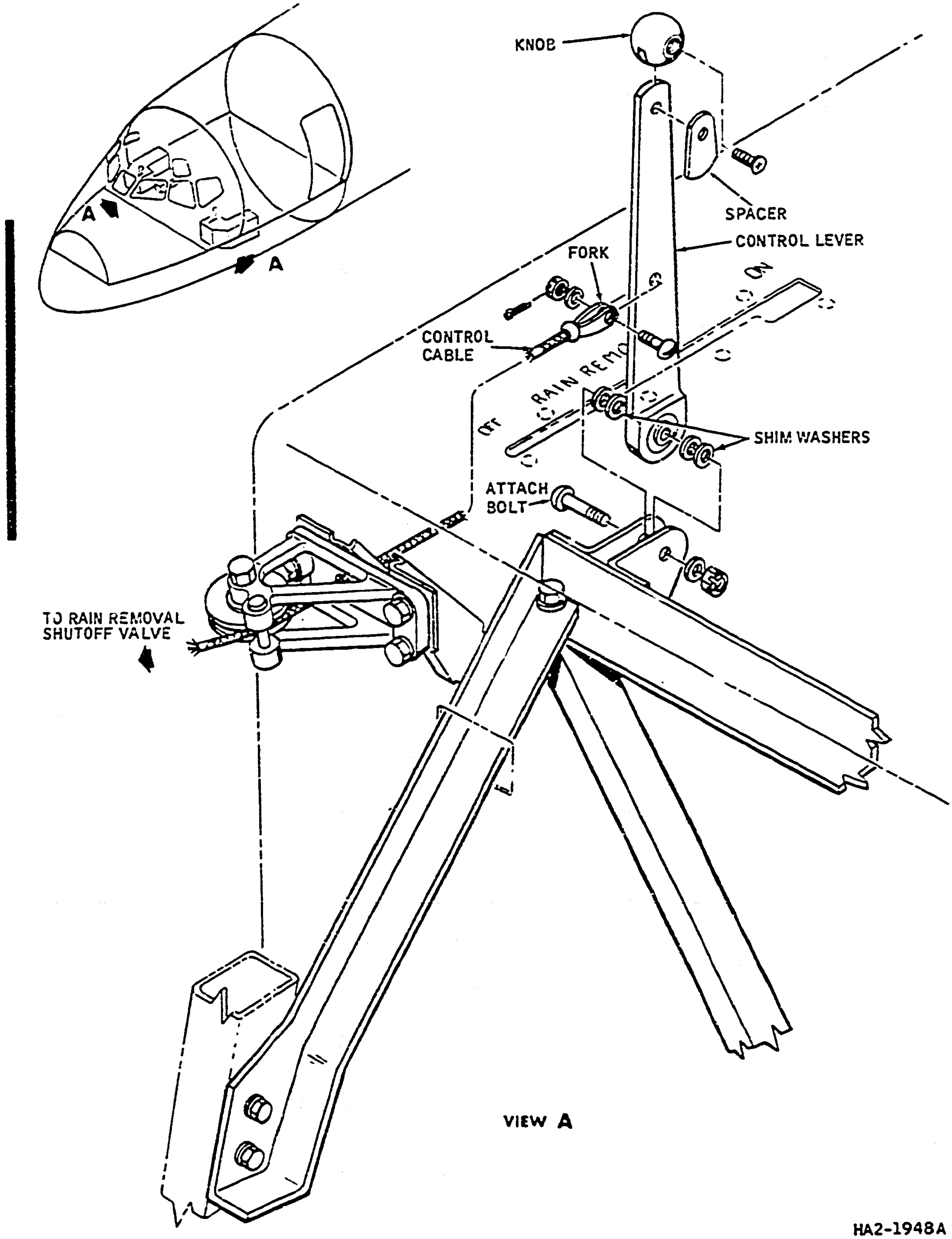
      (3) Install shim washers, positioning as recorded during removal.

         NOTE: Use flat washers as necessary to eliminate all sideplay of the lever on attaching bolt. Position washers on each side of lever so that handle is slightly preloaded against the outboard edge of detent in console.

      (4) Connect windshield rain removal shutoff valve control cable to lever.

         NOTE: The cable fork must be free to swivel after installation.

      (5) Install knob and spacer on lever.



Windshield Pneumatic Rain Removal Control
Levers -- Installation
Figure 201

WINDSHIELD PNEUMATIC RAIN REMOVAL DRAIN VALVE - MAINTENANCE PRACTICES

1. General

   A. The removal and installation procedures for the left and right windshield pneumatic rain removal drain valves are identical.

   B. Access to the drain valves is through access doors located on the upper surface of the fuselage nose.

2. Removal/Installation Windshield Pneumatic Rain Removal Drain Valves

   A. Remove Drain Valve

      (1) Disconnect drain line from windshield pneumatic rain removal drain valve.

      (2) Remove valve from pneumatic duct. Discard O-ring.

   B. Install Drain Valve

      (1) Using new O-ring, install windshield pneumatic rain removal drain valve on pneumatic duct.

      (2) Connect drain line to valve.

WINDSHIELD LIQUID RAIN REPELLENT SYSTEM -

DESCRIPTION AND OPERATION

1. General

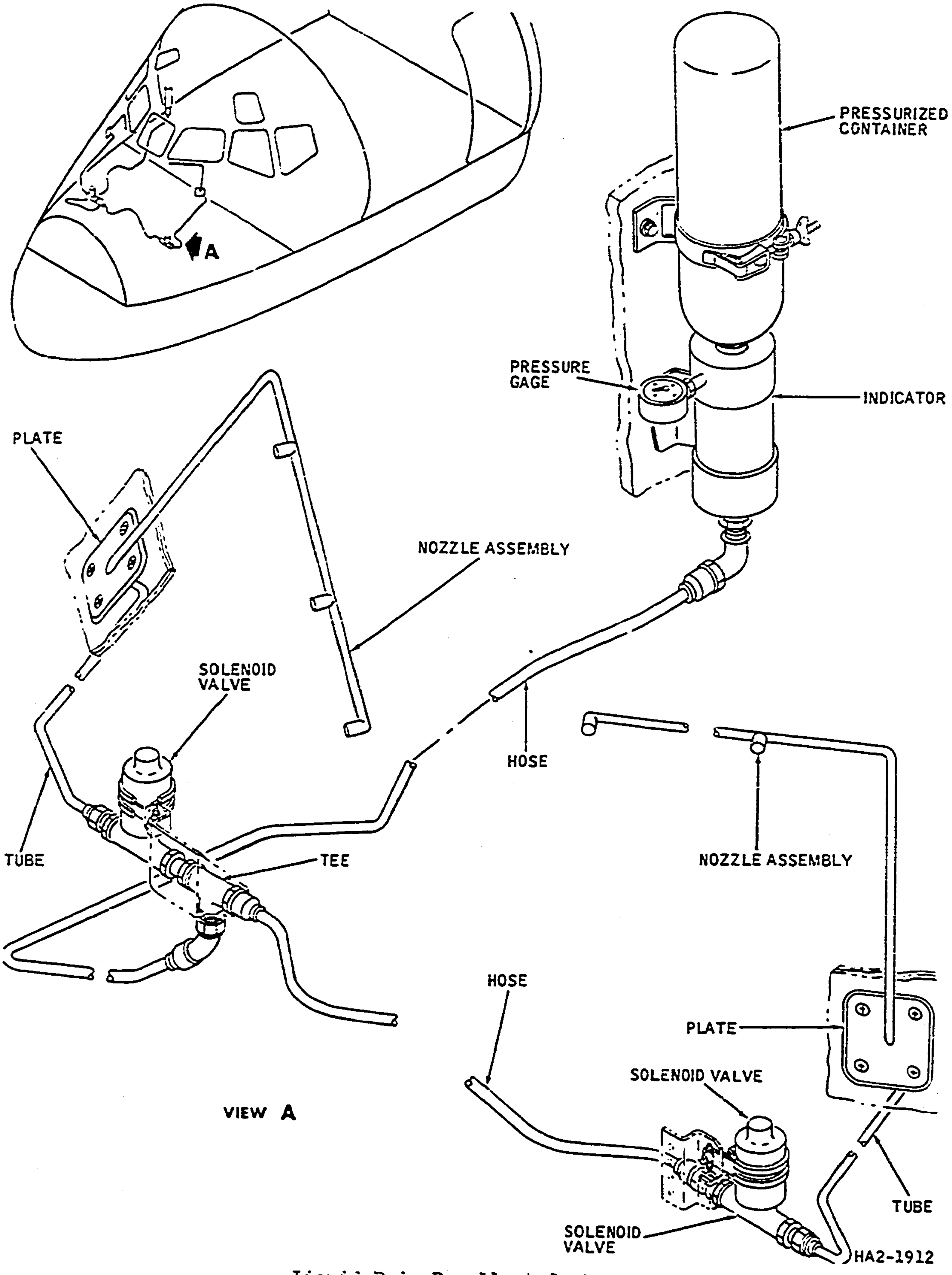
A. The liquid rain repellent system uses a liquid rain repellent, stored in a pressurized container, to remove rain from the windshields. The system, on demand, dispenses repellent fluid on the outer surfaces of the left and right windshields, either individually or simultaneously, to aid in removing rain water from these surfaces.

2. Description

A. The system consists of one replaceable pressurized fluid container, a transparent fluid level indicator, a pressure gage, two solenoid-actuated valves, two spray nozzles, two momentary pushbutton switches, a control switch, a time delay relay, and the necessary plumbing and wiring to interconnect and operate the system. All components, with the exception of the fluid-dispensing nozzles, are located in the flight compartment. Electrical power is required to actuate the solenoid valves.

B. The fluid container, located on the copilot's console, is pressurized to approximately 90 psig when fully charged and holds approximately 500 cc. The transparent fluid level indicator and pressure gage is located below the fluid container and indicates the fluid level and the system pressure. The fluid level indicator check valve is held open when a container is installed in order to prevent line pressure build up. Each solenoid-actuated valve, located just forward of the windshield, is actuated in response to a pushbutton switch. The time delay relay, located in the forward electrical power center, automatically shuts off electrical power to the solenoid approximately 0.24 second after the pushbutton switch is depressed, thus closing the valve. Approximately 6 cc of fluid is dispensed on the windshield while the valve is open. The repellent causes water to form beads and roll off the glass. The slipstream across the windshield will continually remove the water beads leaving a large part of the windshield clear.

C. The repellent is effective for varying lengths of time, depending on rain intensity. A small amount of washing will make the windshield again receptive to the repellent. The repellent fluid is not a window-washing solution and should never be applied to a dry windshield. When used on a dry windshield, repellent will dry, and visibility will be reduced.



Liquid Rain Repellent System --
Functional Schematic
Figure 1

3. Operation

A. The liquid rain repellent system should be used only during moderate-to-heavy rain, and in conjunction with the pneumatic rain removal system, which helps to spread the fluid across the windshield. To operate the system, depress one or both momentary pushbutton switches. Due to aspiration of the system lines by the slipstream, the momentary pushbutton switches may have to be depressed several times (during the initial surge) in order to pressurize the lines and dispense the fluid on the windshield. When the pushbutton is depressed, the solenoid valve opens for 0.24 second, and approximately 6 cc of fluid is sprayed on the windshield. Because fluid is supplied to both windshields from the same container, it is desirable to depress one pushbutton switch before the other to spray the maximum amount of fluid on the windshield. However, both switches may be activated simultaneously, if required. The fluid quantity can be monitored on the transparent fluid level indicator and the container pressure can be monitored on the pressure gage.

WARNING: THE LIQUID RAIN REPELLENT SYSTEM MUST NOT BE LEFT WITHOUT A CONTAINER INSTALLED, UNLESS THE SYSTEM BLEED PORT VALVE IS OPENED. UNDESIRABLY HIGH PRESSURE CAN DEVELOP IN THE CLOSED SYSTEM UNDER CERTAIN AMBIENT TEMPERATURE CONDITIONS, IF A CONTAINER IS NOT INSTALLED.

WINDSHIELD LIQUID RAIN REPELLENT SYSTEM - TROUBLE SHOOTING

1. General

   A. The windshield liquid rain repellent container and time delay relay are located in the flight compartment on the first officer's console and the forward electrical power center respectively. The solenoid valves are located in the flight compartment, below the forward of the left and right side windshields.

2. Tools and Equipment Required

   A. A multitester, model 260 Simpson or equivalent, is required to perform trouble shooting procedures.

3. Trouble Shooting

Possible Causes	Isolation Procedures	Correction
A. RAIN REPELLENT SYSTEM INOPERATIVE		
(1) Supply container exhausted	Check container	Replace container
(2) Solenoid valve defective.	With switch on, check solenoid for operation. If solenoid does not energize and electrical power is present at solenoid, valve is defective.	Replace solenoid valve.
(3) Loose connection or leaking fluid line	Check lines and connections.	Replace or repair as necessary.
(4) Rain repellent switch defective.	By-pass switch and apply electrical power to system. If system becomes energized, switch is defective.	Replace switch

	Possible Causes	Isolation Procedures	Correction
A.	RAIN REPELLENT SYSTEM INOPERATIVE (Continued)		
(5)	Time delay relay defective.	With rain repellent switch depressed, check for electrical power at output of relay. If power is not present and is present at input, relay is defective.	Replace relay.
(6)	System circuitry defective.	Using multitester, perform point to point check of electrical system.	Repair or replace as necessary.
B.	RAIN REPELLENT FLUID FAILS TO SHUT OFF AFTER 0.3 SECOND		
(1)	Time delay relay defective.	Using stop watch, check time cycle of relay. If relay does not function in tolerance, it is defective.	Replace time delay.

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WINDSHIELD LIQUID RAIN REPELLENT SYSTEM - MAINTENANCE PRACTICES

1. General

A. All components and controls of the windshield liquid rain repellent system, with the exception of the fluid-dispensing nozzles, are located in the flight compartment.

2. Tools and Equipment Required

NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Bleed hose		Local	Bleed gas from system
B	Container		Local	Catch and measure spillage
C	Steel wire		Local	Cleaning nozzle
D	Stoddard solvent	P-D-680	Local	Cleaning nozzle

3. Servicing

NOTE: After any maintenance operation envolving depressurization of the rain repellent system, or after installation of a new repellent container, it is necessary to bleed the pressurizing gas and/or air from the system.

A. Bleed Windshield Liquid Rain Repellent System

(1) Attach bleed hose to bleed valve on quantity indicator, and place open end of hose into suitable container.

(2) Open bleed valve to bleed pressurizing gas from system and indicator sight glass. Bleed system until fluid with no gas escapes from bleed hose and indicator sight glass is filled with fluid.

CAUTION: DO NOT ALLOW ANY SPILLED REPELLENT SOLUTION TO REMAIN IN CONTACT WITH AIRPLANE STRUCTURE. ALL REPELLENT SOLUTION SHOULD BE WASHED OFF WITHIN 2 HOURS AFTER BEING APPLIED.

(3) Pressurize system by depressing each pushbutton switch several times or until repellent fluid strikes windshields.

(4) Clean windshield and surrounding areas with soap and water.

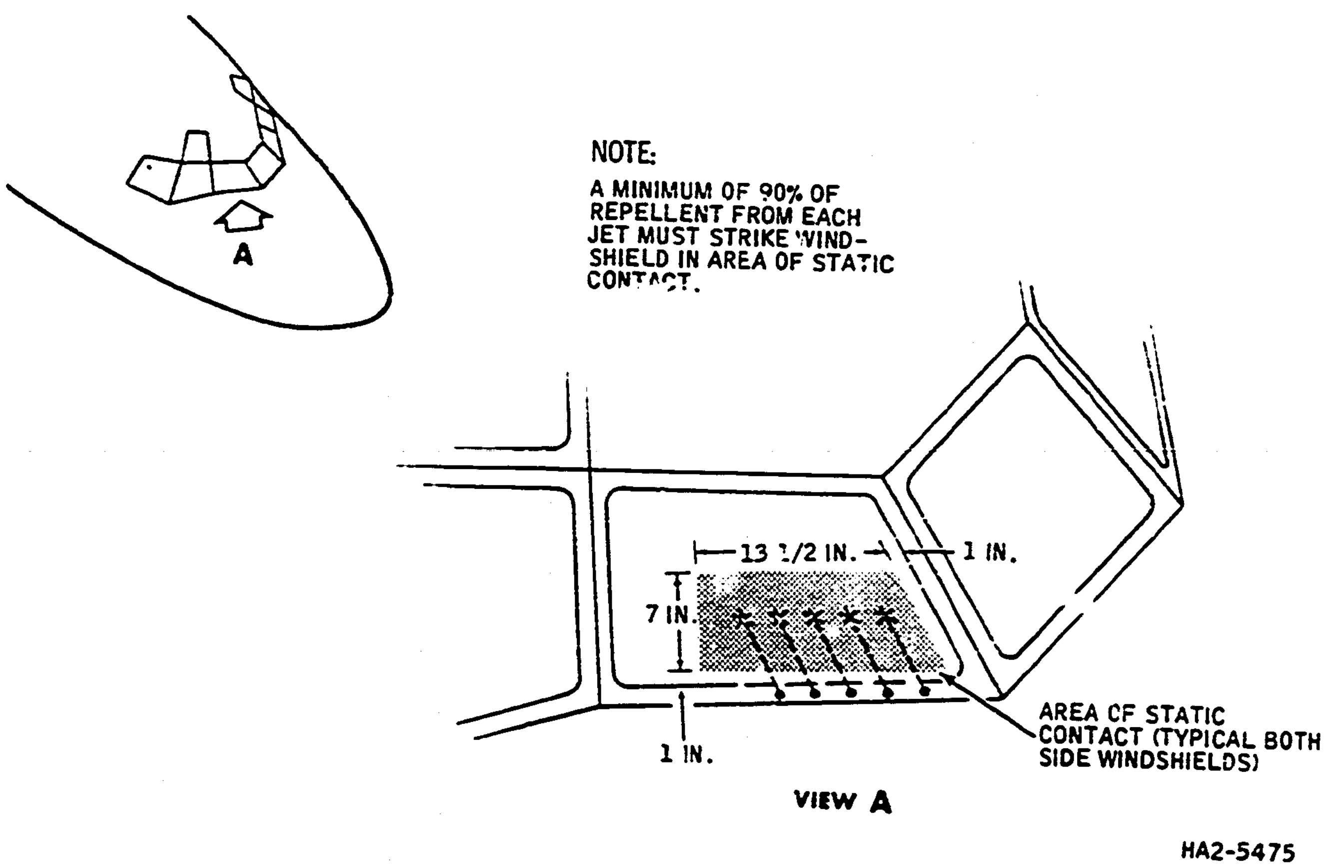
CAUTION: DO NOT ALLOW REPELLENT SOLUTION TO REMAIN IN CONTACT WITH AIRPLANE STRUCTURE. ALL REPELLENT SOLUTION SHOULD BE WASHED OFF WITHIN 2 HOURS AFTER BEING APPLIED.

4. Adjustment/Test Windshield Liquid Rain Repellent System

A. Test Windshield Liquid Rain Repellent System

(1) Pressurize system by depressing each pushbutton switch several times or until repellent fluid strikes windshield.

(2) Depress each pushbutton switch once and collect fluid discharged from each nozzle in suitable graduated container. Each nozzle should dispense 6 (±0.25) cc of fluid.



Windshield Liquid Rain Repellent Static Contact Area
Figure 201

(3) Depress each pushbutton switch once and check fluid impingement on windshield. Fluid should strike each windshield in approximately same area. (See Figure 201.)

(4) Clean windshield and surrounding areas with soap and water.

<u>CAUTION</u>: DO NOT ALLOW REPELLENT SOLUTION TO REMAIN IN CONTACT WITH AIRPLANE STRUCTURE. ALL REPELLENT SOLUTION SHOULD BE WASHED OFF WITHIN 2 HOURS AFTER BEING APPLIED.

5. <u>Cleaning/Painting Spray Nozzle</u>

A. Clean Spray Nozzle

(1) Clogged nozzle orifices may be cleared with a fine steel wire. Stoddard solvent or equivalent is suitable for dissolving repellent residue in clogged nozzles.

WINDSHIELD LIQUID RAIN REPELLENT CONTAINER - MAINTENANCE PRACTICES

1. General

A. The windshield liquid rain repellent container is located on the copilot's console in the flight compartment.

B. The liquid rain repellent container should be replaced if the fluid level indicator indicates low fluid quantity or the pressure gage indication is in the yellow band.

2. Removal/Installation Windshield Liquid Rain Repellent Container

A. Remove Rain Repellent Container

(1) Open left and right rain repellent circuit breakers located on miscellaneous section of EPC circuit breaker panel.

(2) Open container - retaining clamp.

(3) Unscrew and remove container. Discard gasket.

(4) Open bleed port valve.

WARNING: THE LIQUID RAIN REPELLENT SYSTEM MUST NOT BE LEFT WITHOUT A CONTAINER INSTALLED UNLESS THE SYSTEM BLEED PORT VALVE IS OPENED. UNDESIRABLY HIGH PRESSURE CAN DEVELOP IN THE CLOSED SYSTEM UNDER CERTAIN AMBIENT TEMPERATURE CONDITIONS, IF A CONTAINER IS NOT INSTALLED.

B. Install Rain Repellent Container

(1) Make certain that left and right rain repellent circuit breakers located on miscellaneous section of EPC circuit breaker panel are open.

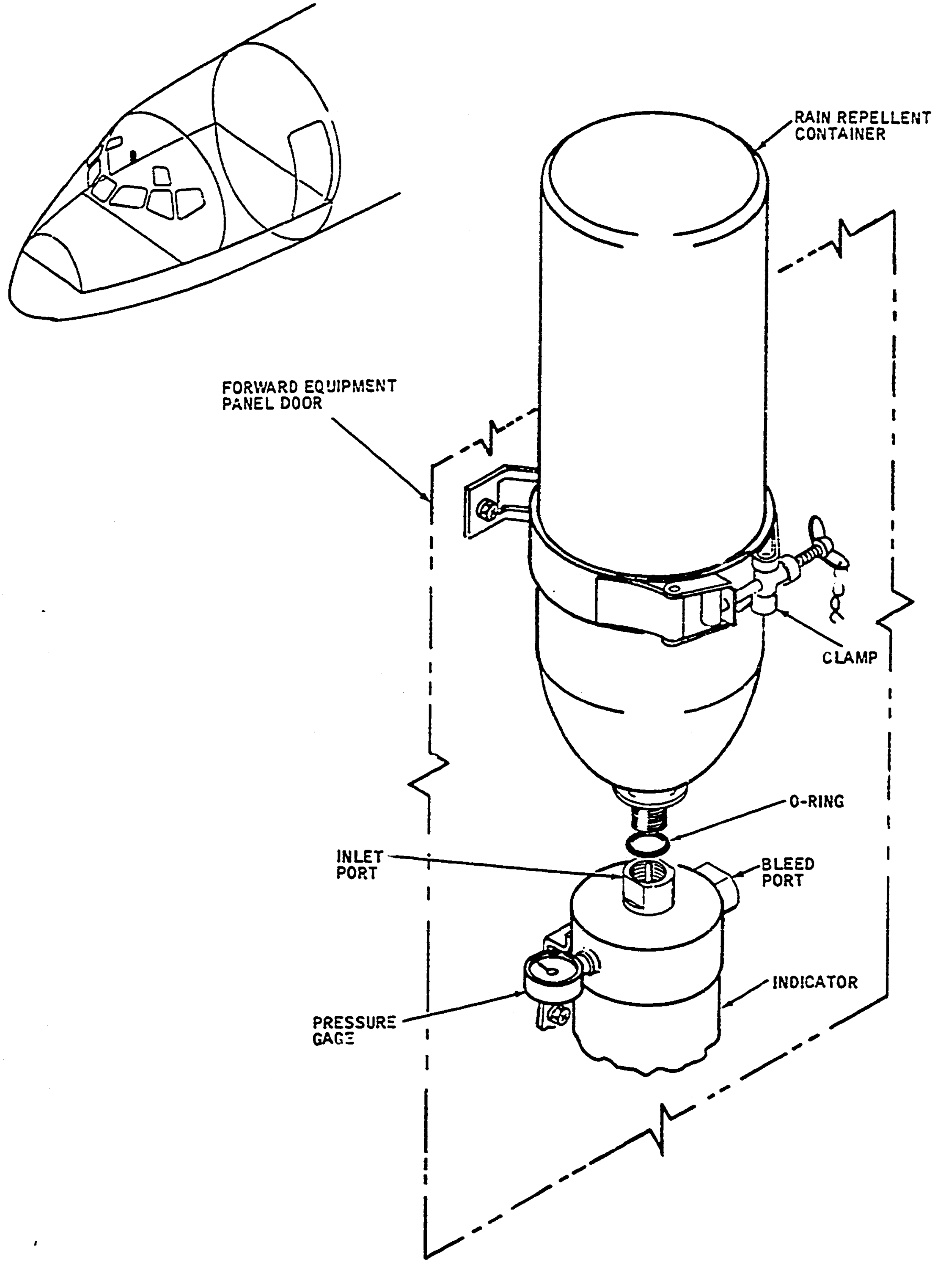
(2) Close bleed port valve.

(3) Using new gasket, install container. Tighten to maximum fingertightness.

(4) Close and fasten retaining clamp. Tighten wingnut to maximum fingertighteness.

(5) Close left and right rain repellent circuit breakers.

(6) Bleed rain repellent system (see 30-43-0, Maintenance Practices).



Windshield Liquid Rain Repellent
Container -- Installation
Figure 201

WINDSHIELD LIQUID RAIN REPELLENT QUANTITY INDICATOR - MAINTENANCE PRACTICES

1. General

A. The windshield liquid rain repellent quantity indicator is located just below the rain repellent container on the copilot's console in the flight compartment.

B. Access to the quantity indicator is through the flight compartment.

2. Tools and Equipment Required

A. Drip pan of suitable size to catch excess fluid when supply line is disconnected.

3. Removal/Installation Windshield Liquid Rain Repellent Quantity Indicator

A. Remove Rain Repellent Quantity Indicator

(1) Open left and right rain repellent circuit breakers located on miscellaneous section of EPC circuit breaker panel.

(2) Open container-retaining clamp.

(3) Remove repellent container. (see 30-43-1 Maintenance Practices)

WARNING: WITH REPELLENT CONTAINER INSTALLED, SYSTEM IS PRESSURIZED TO APPROXIMATELY 90 PSI. BEFORE REMOVING ANY COMPONENT, CONTAINER MUST BE REMOVED AND SYSTEM DEPRESSURIZED TO AVOID UNDESIRABLY HIGH PRESSURE WHICH CAN DEVELOP IN THE CLOSED SYSTEM UNDER CERTAIN AMBIENT TEMPERATURE CONDITIONS, AND TO AVOID SPRAYING REPELLENT FLUID ON PERSONNEL AND INTERIOR OF FLIGHT COMPARTMENT.

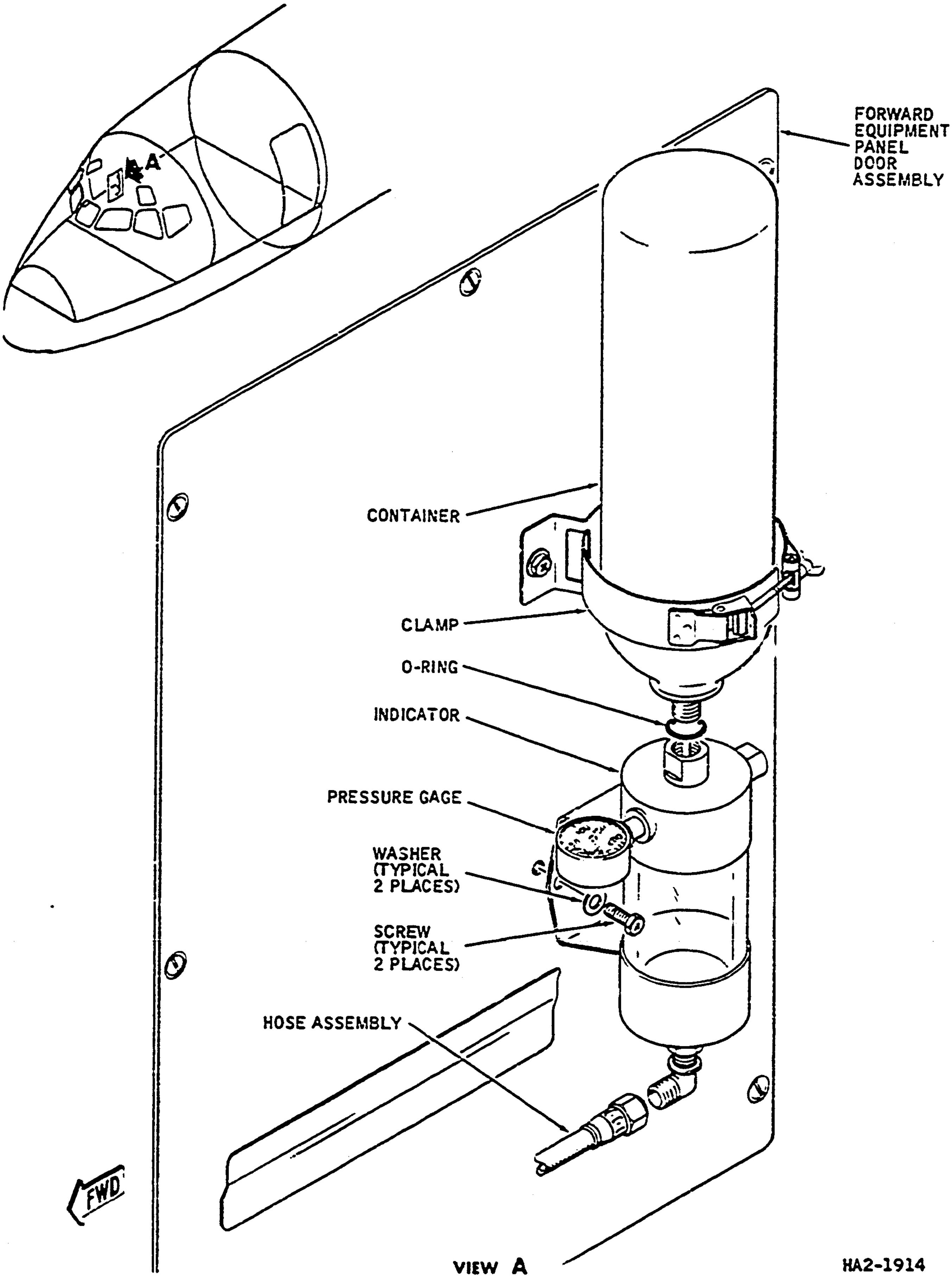
(4) Disconnect fluid supply hose from bottom of quantity indicator.

NOTE: Use drip pan to catch fluid from disconnected supply line.

(5) Remove quantity indicator from console.

(6) Clean drip pan with soap and water to prevent corrosion.

CAUTION: DO NOT ALLOW ANY SPILLED REPELLENT SOLUTION TO REMAIN IN CONTACT WITH AIRPLANE STRUCTURE. ALL REPELLENT SOLUTION SHOULD BE WASHED OFF WITHIN 2 HOURS AFTER BEING APPLIED.



Windshield Liquid Rain Repellent Quantity
Indicator -- Installation
Figure 201

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B. Install Rain Repellent Quantity Indicator

(1) Make certain the left and right rain repellent circuit breakers located on miscellaneous section of EPC circuit breaker panel are open.

(2) Install quantity indicator on console.

(3) Connect fluid supply hose to fitting at bottom of indicator.

(4) Install repellent container (see 30-43-1 Maintenance Practices).

(5) Close left and right rain repellent circuit breakers.

(6) Bleed rain repellent system (see 30-43-0, Maintenance Practices).

WINDSHIELD LIQUID RAIN REPELLENT SOLENOID VALVES - MAINTENANCE PRACTICES

1. General

   A. The windshield liquid rain repellent solenoid valves are located in the flight compartment, below and forward of the left and right side windshields.

   B. Access to the solenoid valves is through the flight compartment.

   C. With the exception of the left solenoid valve which has only one supply hose connection, the installation and removal procedures for the solenoid valves are identical.

2. Removal/Installation Windshield Liquid Rain Repellent Solenoid Valves

   A. Remove Solenoid Valve

      (1) Open left and right rain repellent circuit breakers located on miscellaneous section of EPC circuit breaker panel.

      (2) Disconnect electrical connector from solenoid valve.

      (3) Remove repellent container (see 30-43-1 Maintenance Practices).

      WARNING: WITH REPELLENT CONTAINER INSTALLED, SYSTEM IS PRESSURIZED TO APPROXIMATELY 90 PSI. BEFORE REMOVING ANY COMPONENT, CONTAINER MUST BE REMOVED AND SYSTEM DEPRESSURIZED TO AVOID UNDESIRABLY HIGH PRESSURE WHICH CAN DEVELOP IN THE CLOSED SYSTEM UNDER CERTAIN AMBIENT TEMPERATURE CONDITIONS, AND TO AVOID SPRAYING REPELLENT FLUID ON PERSONNEL AND INTERIOR OF FLIGHT COMPARTMENT.

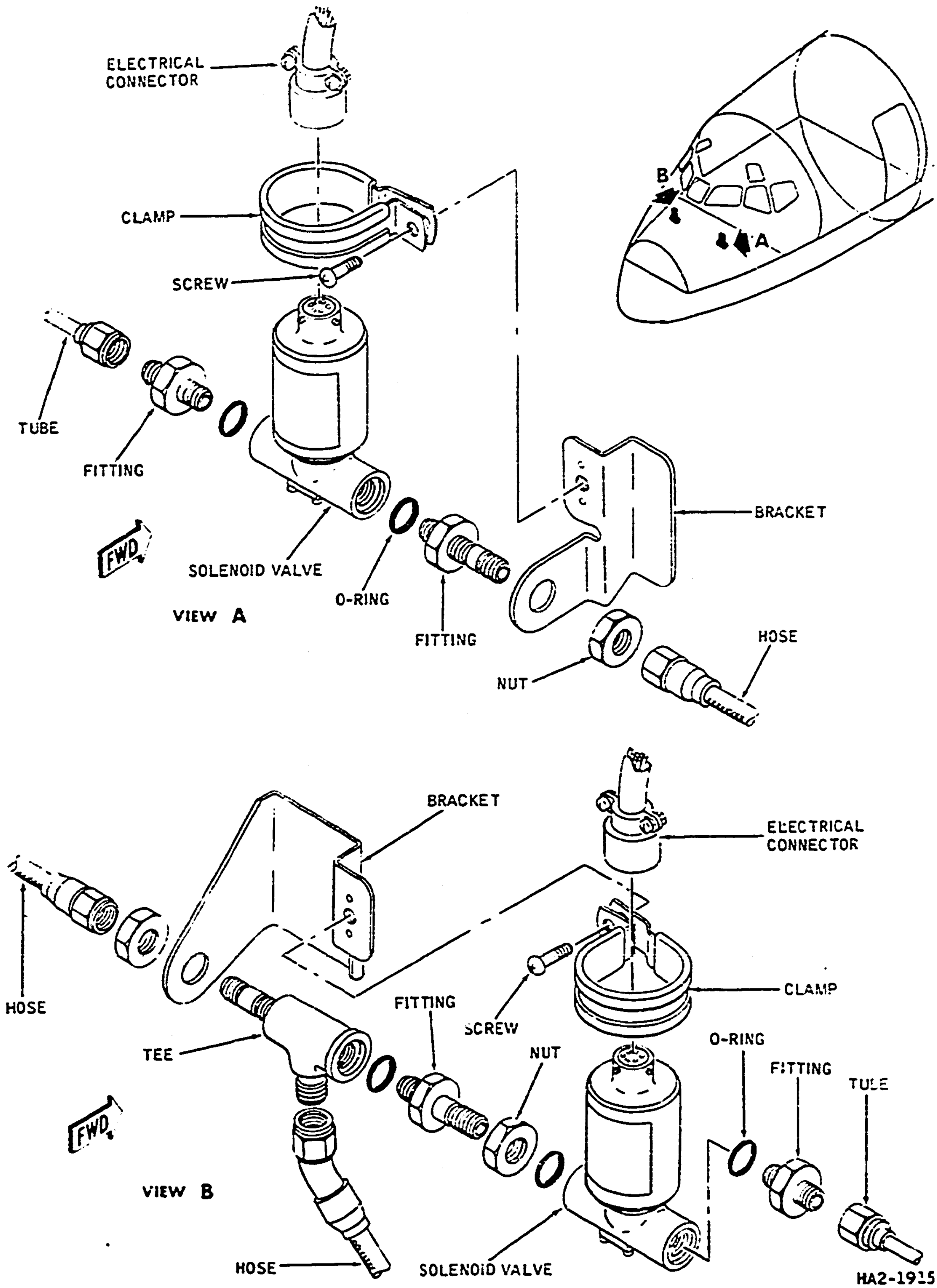
      (4) Disconnect supply hose(s) from solenoid valve fitting.

      (5) Disconnect nozzle supply line from valve.

      (6) Remove retaining clamp.

      (7) Remove valve from support bracket.

      (8) Remove fittings from solenoid valve. Discard O-rings.



Windshield Liquid Rain Repellent Solenoid
Valves -- Installation
Figure 201

B. Install Solenoid Valves

(1) Make certain that left and right rain repellent circuit breakers located on miscellaneous section of EPC circuit breaker panel are open.

(2) Using new O-rings, install fittings in solenoid valve.

(3) Install valve on mounting bracket.

(4) Install retaining clamp on valve.

(5) Connect nozzle supply line to valve.

(6) Connect supply hose(s) to valve.

(7) Connect electrical connector to valve.

(8) Close left and right rain repellent circuit breakers.

(9) Install repellent container (see 30-43-1, Maintenance Practices).

(10) Bleed rain repellent system (see 30-43-0, Maintenance Practices).

WATER LINES - DESCRIPTION AND OPERATION

1. General

A. Ice protection of the water lines consists of thermostatically controlled heating elements on the water system drain panel, a heating element in the forward and aft waste water drain masts, and on airplanes N8966U through N8975U, heating elements on each waste water service panel.

B. The potable water system drain panel heating element is a fabricated assembly consisting of a formed brass pan with a circular, rod-type resistance heating element brazed to the pan near its outer flange. The element operates on 115-volt, 400-cycle, ac power and is rated at 50 watts. Screw-type electrical terminals, one connected to each end of the element rod, and a temperature sensitive control switch are located between the ends of the element and are insulated with a moulded rubber sheath. The terminals provide connections to the airplane electrical system. The center area of the base pan incorporates two holes where the water connection nipple and a plug pass through the pan. Gaskets around the nipple and plug and under the base pan retain fuselage pressurization while nuts on the nipple and plug secure the heater to the fiberglass service panel plate. A hard-rubber abrasion ring is installed between the edge of the heating element base pan and the fiberglass plate to prevent the edge of the pan from cutting the plate.

C. The waste water drain mast heaters consist of [illegible]e containing a resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

D. The waste water service panel heaters on airplanes N8966U through N8975U are molded assemblies of silicone rubber, each containing a resistance-type heating element and necessary electrical wiring for connecting to the airplane electrical system. There are two types of heaters used on the waste water service panels. One type surrounds the toilet drain fitting and is rated at 15 watts at 115-vac. The second type surrounds the toilet flush fitting and is rated at 8 watts at 115-vac.

2. Operation

A. The potable water system drain panel heater (See Figure 1) operates from the 115-vac cabin bus 4 through the water service panel heater circuit breaker. The temperature sensitive switch, located on the heater element, provides thermostatic control. Heater operation is automatic when the circuit breaker is closed and cabin bus 4 is energized.

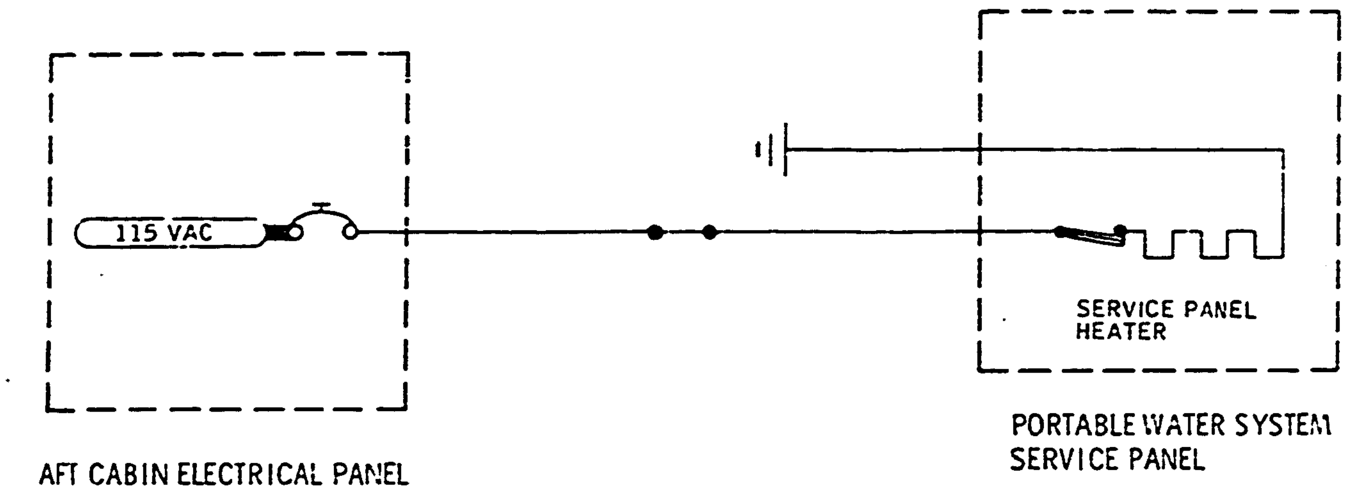
B. The waste water drain mast heaters (See Figure 2) operate on 115-vac power when in flight, and on 28-volt power when on the ground. This provides a high heat range in flight and a low heat range in flight and a low heat range on the ground.

C. When the airplane is in a flight position (strut extended) the nose gear oleo ground shift mechanism cause the ground control relays to deenergize. Contacts of the ground control relays open the 28-vdc circuit and close the circuit between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste waster drain mast heaters.

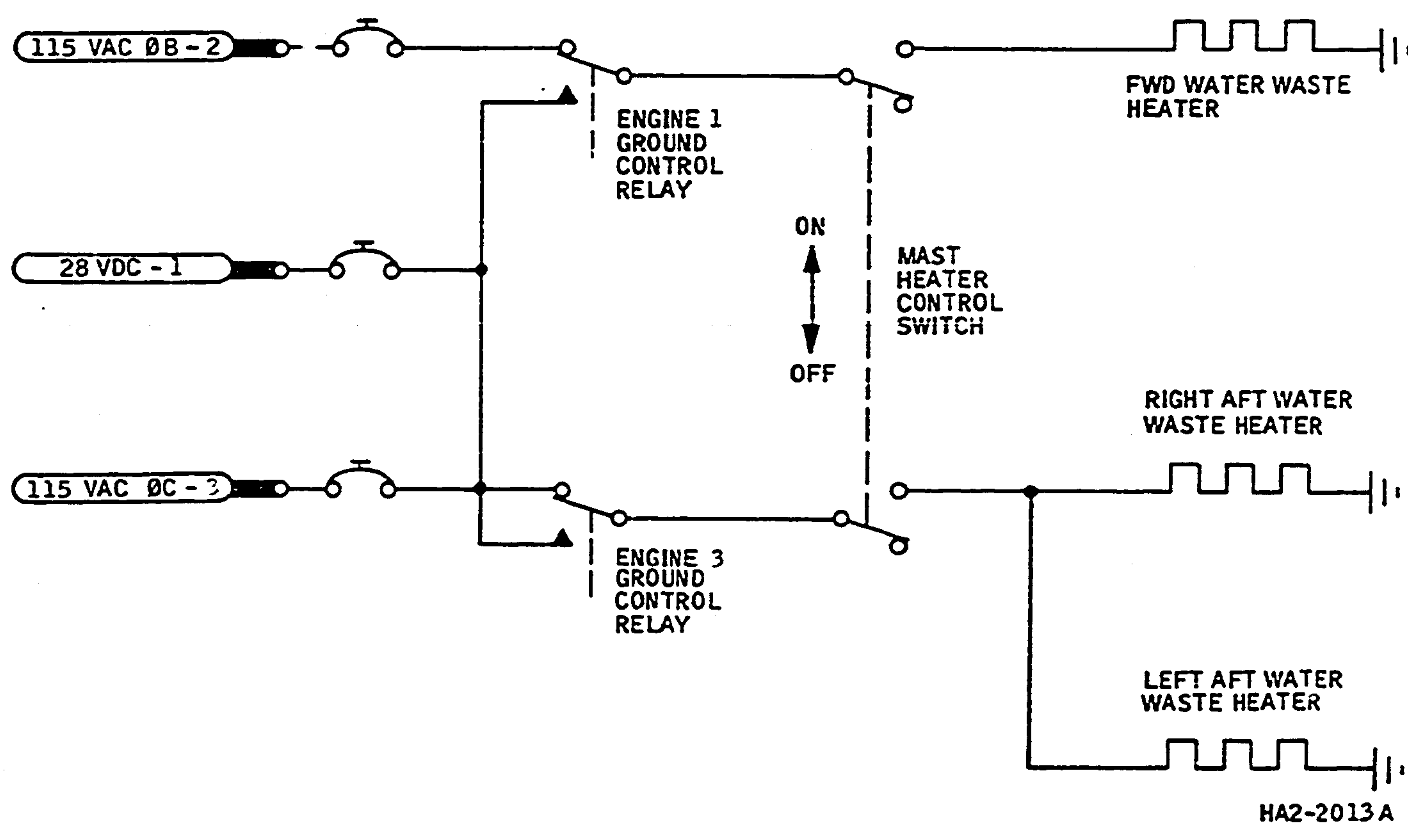
D. With the airplane on the ground (strut compressed) the nose gear oleo ground shift mechanism cause the ground control relays to energize. Contacts of the relay close and 28-vdc power is supplied to the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

E. On airplanes N8092U through N8099U, N8966U through N8975U, an interlock circuit prevents 115-vac external electrical power inadvertently being supplied to the mast heater control switch. When external electrical power is supplying power to the electrical buses, as during ground maintenance, contacts of the No. 1 external power relay close and power is supplied to energize the waste water mast heater external power control relay. If for any reason the ground control relays should be deenergized, 28-vdc continues to be supplied to the mast heater control switch through the energized heater external power control relay.

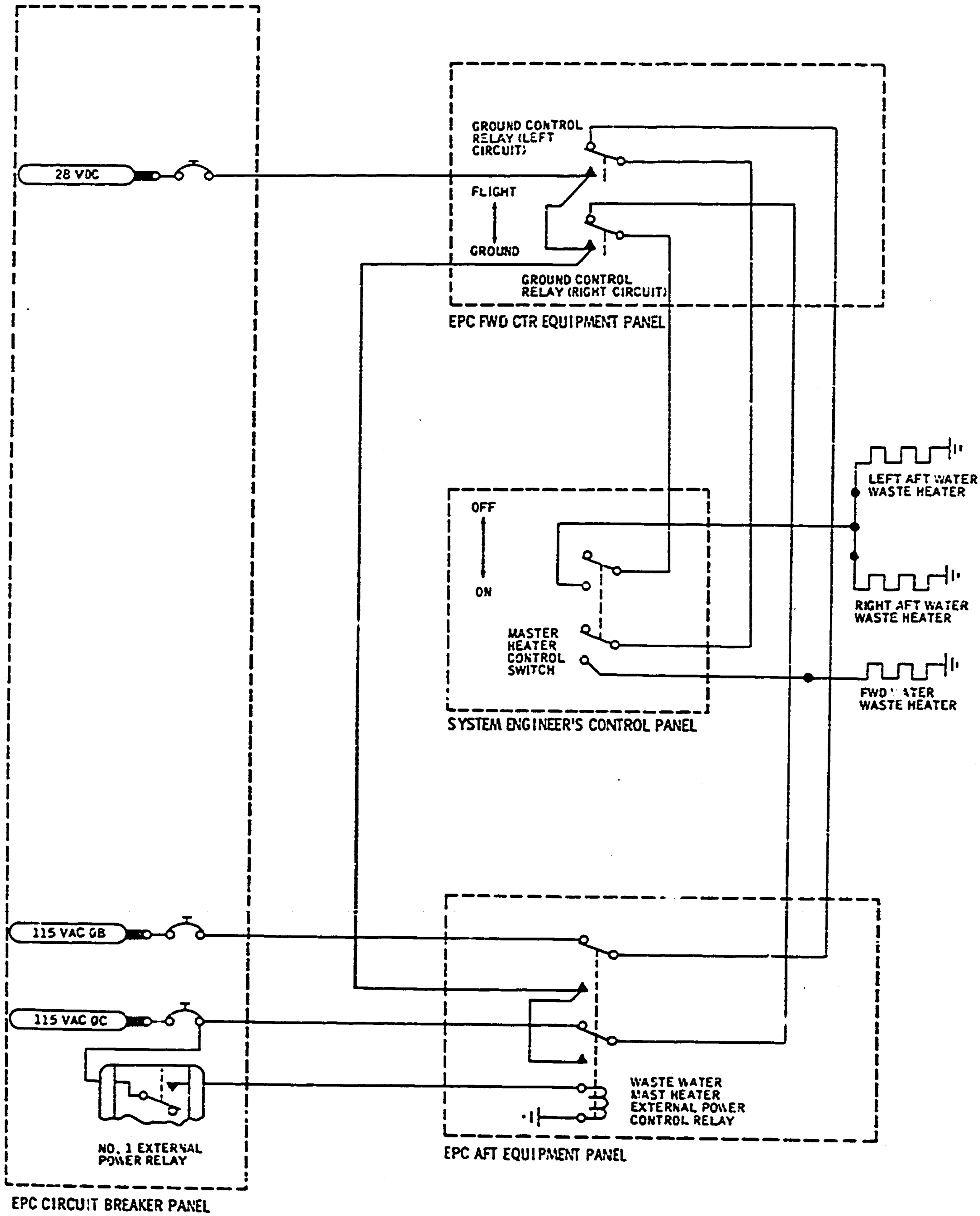
F. The waste water service panel heaters (airplanes N8966U through N8975U) (See Figure 3) are in operation when the 115-vac cabin buses are energized. The heaters on the forward waste-water service panel are energized through a circuit breaker located on the forward cabin electrical panel. The heaters on the two aft waste service panels are energized through a circuit breaker located on the aft cabin electrical panel.



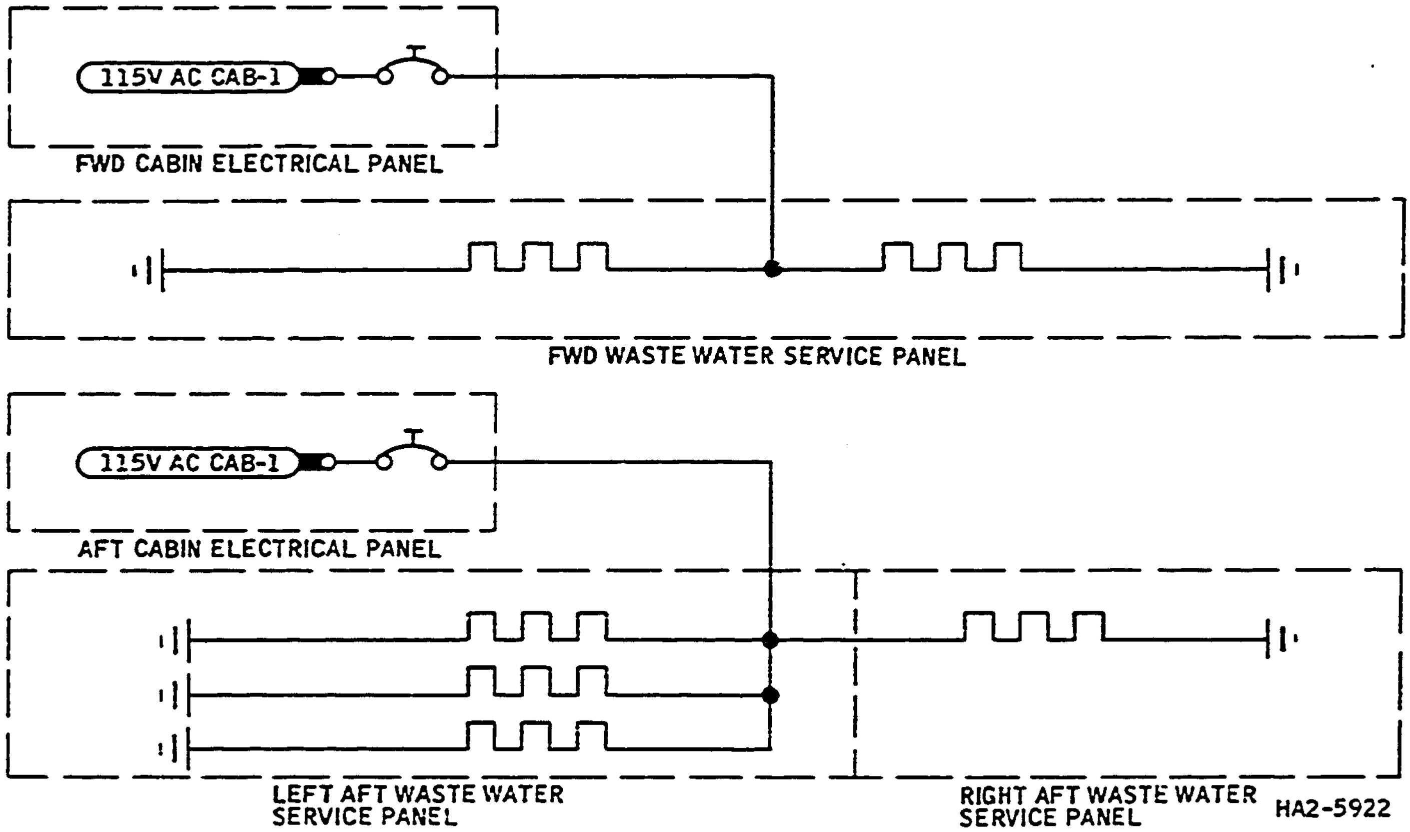
Potable Water System Drain Panel Heater --
Electrical Schematic
Figure 1



Waste Water Drain Mast Heaters -- Electrical Schematic
(Airplanes N8070U - N8091U)
Figure 2 (Sheet 1)



Waste Water Drain Mast Heaters -- Electrical Schematic
(Airplanes N8092U - N8099U, N8966U - N8975U)
Figure 2 (Sheet 2)



Waste Water Service Panel Heaters -- Electrical Schematic
(Airplanes N8966U - N8975U)
Figure 3

WATER LINES - DESCRIPTION AND OPERATION

1. General

A. Ice protection of the water system lines consists of thermostatically controlled heating elements on the potable water system service panel and a heating element in the forward and aft waste water drain masts.

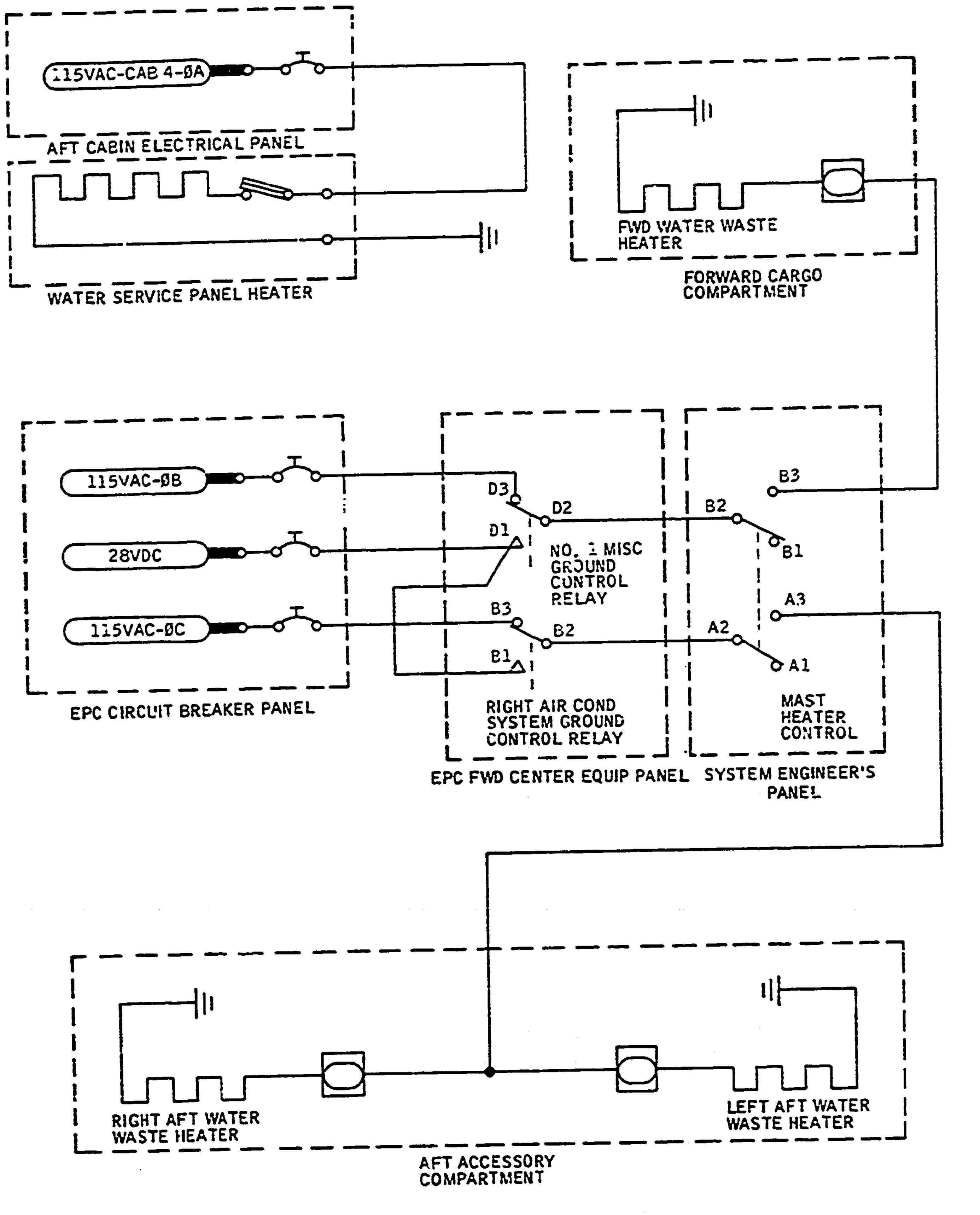
B. The service panel heating elements are fabricated assemblies consisting of a formed brass pan with a circular, rod-type resistance heating element brazed to the pan near its outer flange. The element operates on 115-volt, 400-cycle, ac power and is rated at 50 watts. Screw-type electrical terminals, and is rated at 50 watts. Screw-type electrical terminals, one connected to each end of the element rod, and a temperature sensitive control switch are located between the ends of the element and are insulated with a moulded rubber sheath. The terminals provide connections to the airplane electrical system. The center area of the base pan incorporates two holes where the water connection nipples pass through the pan. Gaskets around the nipples and under the base pan retain fuselage pressurization while nuts on the nipples secure the heater to the fiberglass service panel plate. A hard-rubber abrasion to the fiberglass service panel plate. A hard-rubber abrasion ring is installed between the edge of the heating element base pan and the fiberglass plate to prevent the edge of the pan from cutting the plate.

C. The waste water drain mast heaters consist of a tube containing a resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

2. Operation

A. The potable water system service panel heater operates from the 115-vac cabin bus 4 through the water service panel heater circuit breaker. The temperature sensitive switch, located on the heater, element provides thermostatic control. Heater operation is automatic when the circuit breaker is closed and the cabin bus 4 is energized.

B. The waste water drain mast heaters operate on 115-vac power when in flight, and on 28-volt power when on the ground. This provides a high heat range in flight and a low heat range on the ground.



Waste Water Drain Mast Heaters/Potable Water System
Panel Heater -- Electrical Schematics
Figure 1

C. When in flight, the nose oleo shift mechanism opens the ground control relays, closing the contacts between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast heaters.

D. When on the ground, the nose oleo shift mechanism closes the ground relays, closing the contacts between the 28-vdc water waste circuit breaker and the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

WATER LINES - DESCRIPTION AND OPERATION

1. General

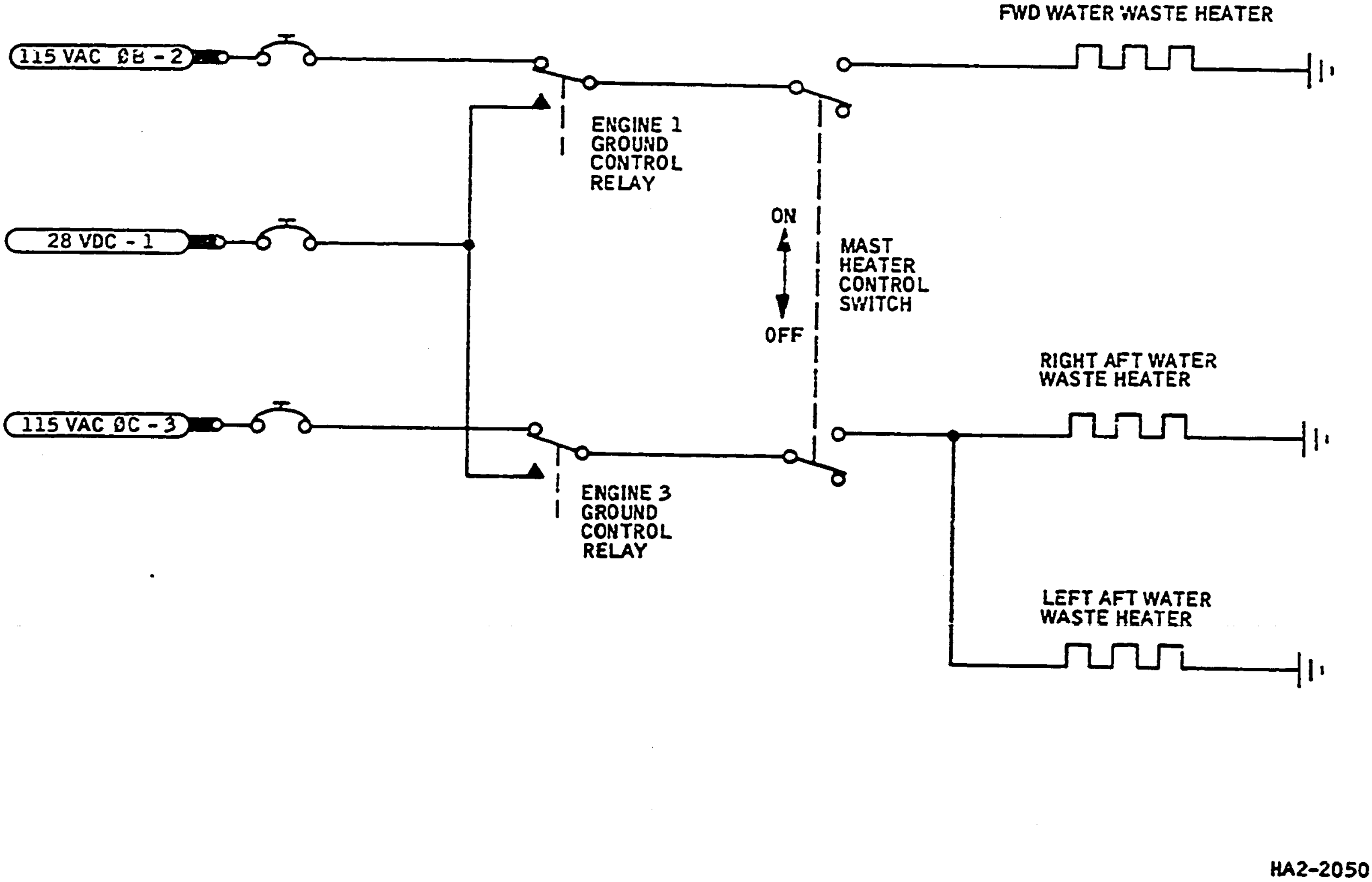
A. Ice protection of the waste water drain mast heaters consists of a tube containing a resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

2. Operation

A. The waste water drain mast heaters operated on 115-vac power when in flight and on 28-volt when on the ground. This provides a high heat range in flight and a low heat range on the ground.

B. When in flight, the nose gear ground shift mechanism deenergizes the No. 1 miscellaneous and right air conditioning system ground control relays, closing the contacts between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high heat range) is supplied to the waste water drain mast heaters.

C. When on the ground, the nose gear ground shift mechanism energizes the No. 1 miscellaneous and right air conditioning system ground control relays, closing the contacts between the 28-vdc water waste circuit breaker and the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.



Waste Water Drain Mast Heaters -- Electrical Schematic
Figure 1

WATER LINES - DESCRIPTION AND OPERATION

1. General

A. Ice protection of the water lines consists of a heating element on the potable water system service panel and a heating element in each forward and aft waste water drain masts.

2. Description

A. The service panel heating elements are fabricated assemblies consisting of a formed brass pan with a circular, rod-type resistance heating element brazed to the pan near its outer flange. The element operates on 115-volt, 400-cycle, ac power and is rated at 50 watts. Screw-type electrical terminals, one connected to each end of the element rod, and a temperature sensitive control switch are located between the ends of the element and are insulated with a moulded rubber sheath. The terminals provide connections to the airplane electrical system. The center area of the base pan incorporates two holes where the water connection nipples pass through the pan. Gaskets around the nipples and under the base pan retain fuselage pressurization while nuts on the nipples secure the heater to the fiberglass service panel plate. A hard-rubber abrasion ring is installed between the edge of the heating element base pan and the fiberglass plate to prevent the edge of the pan from cutting the plate.

B. The waste water drain mast heaters consist of a tube containing a resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

3. Operation

A. The potable water system service panel heater operates from the 115-vac cabin bus 4 through the water service panel heater circuit breaker (see Figure 1). The temperature sensitive switch, located on the heater, element provides thermostatic control. Heater operation is automatic when the circuit breaker is closed and the cabin bus 4 is energized.

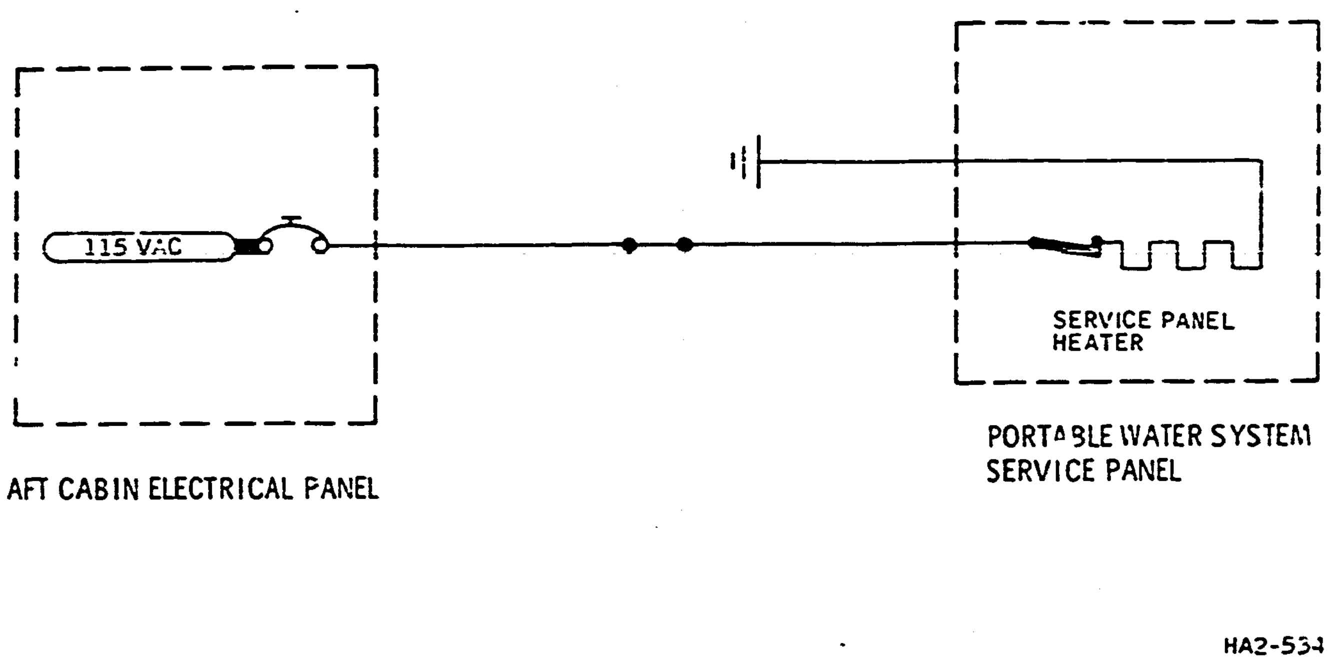
B. The waste water drain mast heaters operate on 115-vac power when in flight, and on 28-volt power when on the ground (see Figure 2). This provides a high heat range in flight and a low heat range on the ground.

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C. With the airplane generator system supplying power to the electrical buses and the airplane on the ground (strut compressed) the nose gear oleo ground shift mechanism cause the ground control relays to energize. Contacts of the relay close and 28-vdc power is supplied to the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

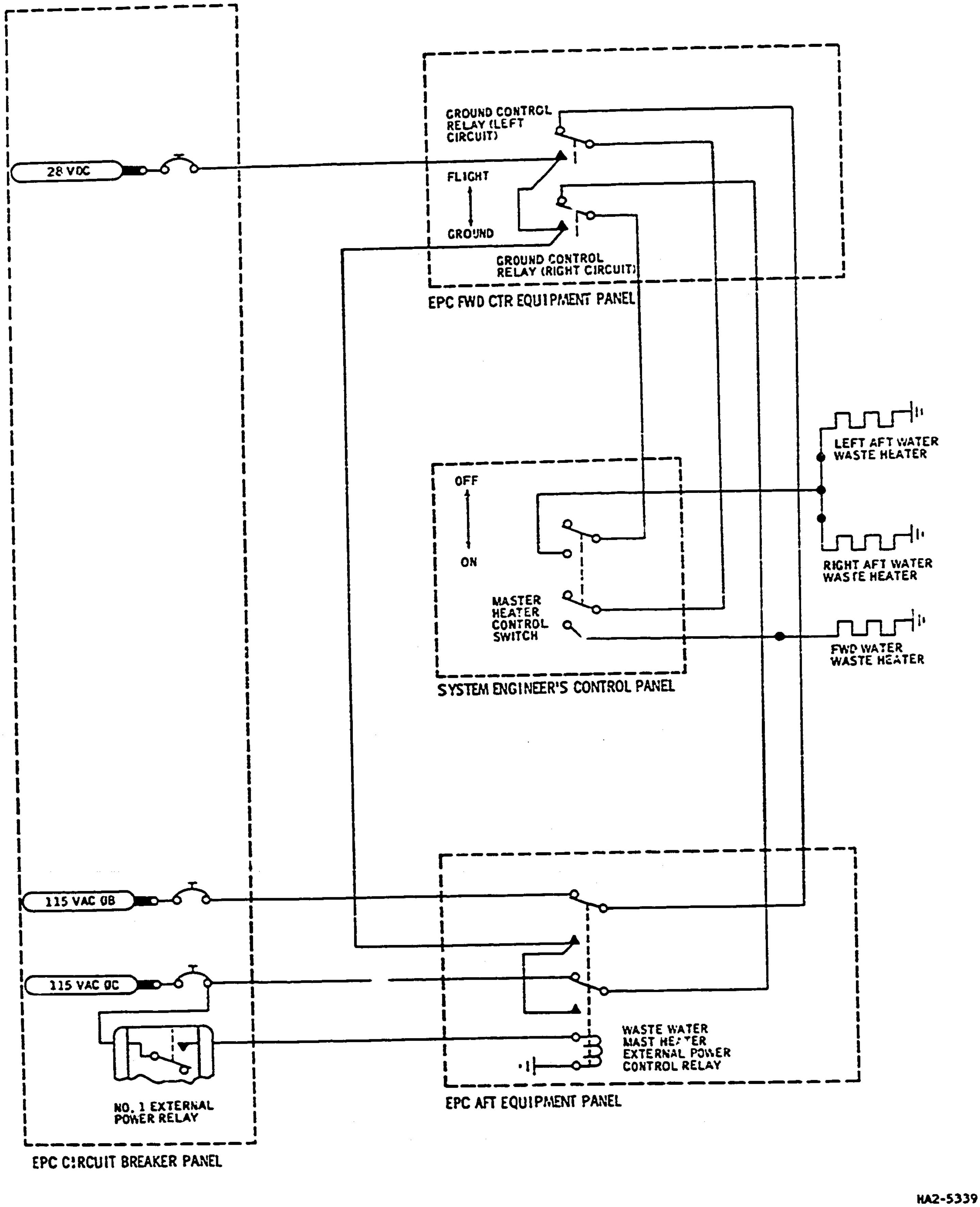
D. When external electrical power is supplying power to the electrical buses, as during ground maintenance, an interlock circuit prevents 115-vac inadvertently being supplied to the mast heater control switch. With external power applied to the airplane, contacts of the No. 1 external power relay close and power is supplied to energize the waste water mast heater external control relay. If for any reason the ground control relays should be deenergized, 28-vdc continues to be supplied to the mast heater control switch through the energized heater external power control relay.

E. When the airplane is in a flight position (strut extended) the nose gear oleo ground shift mechanism cause the ground control relays to deenergize. Contacts of the ground control relays open the 28-vdc circuit and close the circuit between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast heaters.



Potable Water System Service Panel Heater --
Electrical Schematic
Figure 1

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Waste Water Drain Mast Heaters -- Electrical Schematic
Figure 2

WATER LINES - DESCRIPTION AND OPERATION

1. General

A. Ice protection of the water lines consist of a heating element in each forward and aft waste water drain masts.

2. Description

A. The waste water drain mast heaters consists of a tube containing a resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

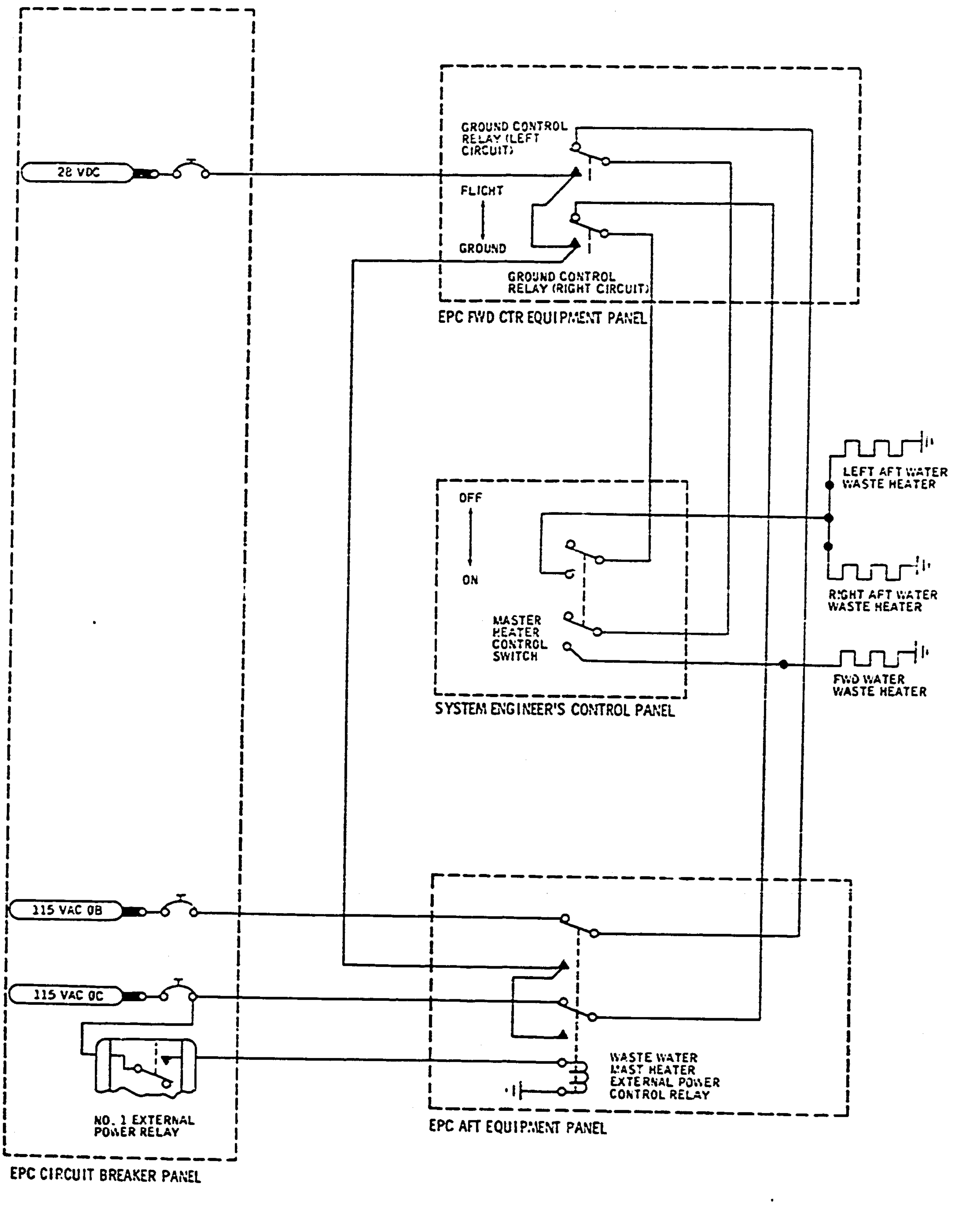
3. Operation

A. The waste water drain mast heaters operate on 115-vac power when in flight and on 28-volt when on the ground. This provides a high heat range in flight and a low heat range on the ground.

B. With the airplane generator system supplying power to the electrical buses and the airplane on the ground (strut compressed) the nose gear oleo ground shift mechanism cause the ground control relays to energize. Contacts of the relay close and 28-vdc power is supplied to the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

C. When external electrical power is supplying power to the electrical buses, as during ground maintenance, an interlock circuit prevents 115-vac inadvertently being supplied to the mast heater control switch. With external power applied to the airplane, contacts of the No. 1 external power relay close and power is supplied to energize the waste water mast heater external control relay. If for any reason the ground control relays should be deenergized, 28-vdc continues to be supplied to the mast heater control switch through the energized heater external power control relay.

D. When the airplane is in a flight position (strut extended) the nose gear oleo ground shift mechanism cause the ground control relays to deenergize. Contacts of the ground control relays open the 28-vdc circuit and close the circuit between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast heaters.



Waste Water Drain Mast Heaters -- Electrical Schematic
Figure 1

WATER LINES - DESCRIPTION AND OPERATION

1. General

A. Ice protection of the water lines consists of a heating element on the potable water system service panel, a heating element on the potable water system drain fitting, and a heating element in each forward and aft waste water drain mast.

2. Description

A. There are two types of heaters used on the potable water system service panel. The first type surrounds the fill and overflow fittings and is a fabricated assembly consisting of a formed brass pan with a circular, rod-type resistance heating element brazed to the pan near its outer flange. The element operates on 115-volt, 400-cycle, ac power and is rated at 50 watts. Screw-type electrical terminals, one connected to each end of the element rod, and a temperature sensitive control switch are located between the ends of the element and are insulated with a moulded rubber sheath. The terminals provide connections to the airplane electrical system. The center area of the base pan incorporates two holes where the water connection nipples pass through the service panel plate. A hard-rubber abrasion ring is installed between the edge of the heating element base pan and the fiberglass plate to prevent the edge of the pan from cutting the plate.

B. The second type of heater surrounds the drain fitting and is a molded assembly of silicone rubber consisting of a resistance-type heating element and necessary electrical wiring for connecting to the airplane electrical system. The heater is rated at 8 watts at 115-vac.

C. The waste water drain mast heaters consist of a tube containing resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

3. Operation

A. The potable water system service panel heater and potable water system drain fitting heater operate from the 115-vac cabin bus 4 through the water service panel heater circuit breaker (see Figure 1). Heater operation is automatic when the circuit breaker is closed and the bus is energized. The service panel heater heats the area around the fill and overflow fittings located on the service panel. Electrical power to the heating element is controlled by the temperature sensitive switch which closes at approximately 65°F (18.3°C). The drain fitting heater heats the area around the drain

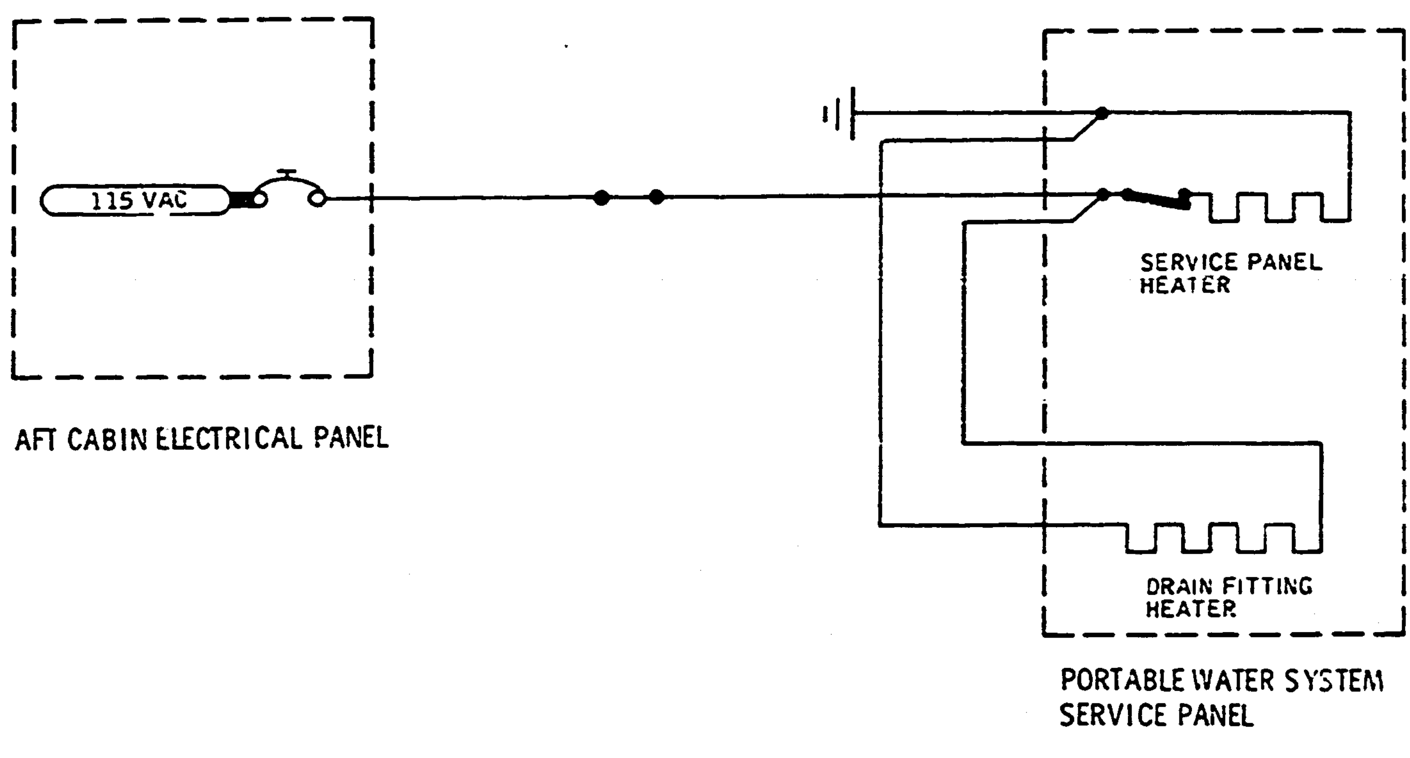
fitting. Electrical power is continuously supplied to the heater element with the circuit breaker closed and the bus energized.

B. The waste water drain mast heaters operate on 115-vac power when in flight, and on 28-volt power when on the ground (see Figure 2). This provides a high heat range in flight and a low heat range on the ground.

C. When the airplane is in a flight position (strut extended) the nose gear oleo ground shift mechanism cause the ground control relays to deenergize. Contacts of the ground control relays open the 28-vdc circuit and close the circuit between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast heaters.

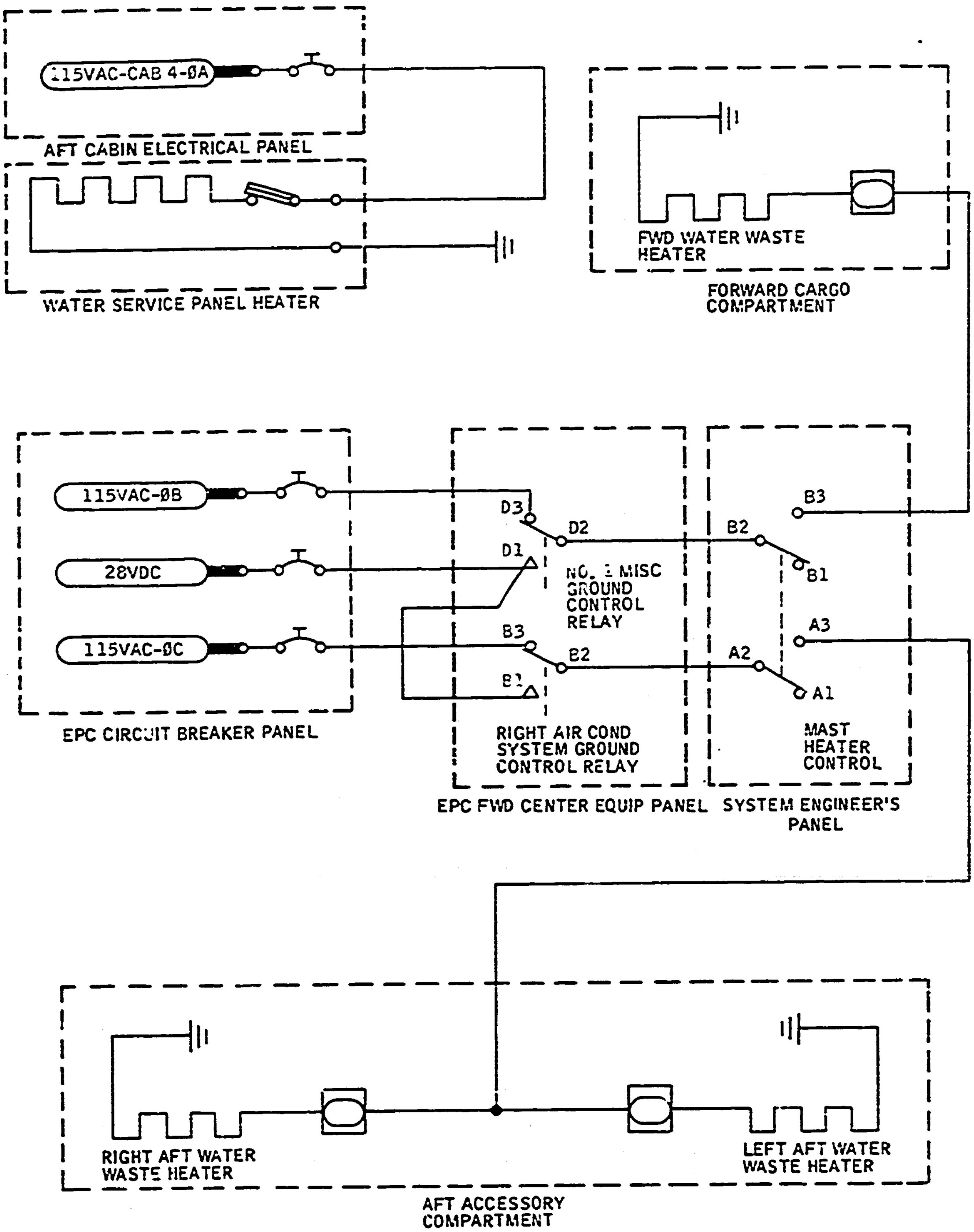
D. With the airplane on the ground (strut compressed) the nose gear oleo ground shift mechanism cause the ground control relays to energize. Contacts of the relay close and 28-vdc is supplied to the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

E. On airplanes 72 and subsequent, an interlock circuit prevents 115-vac external electrical power inadvertently being supplied to the mast heater control switch. When external electrical power is supplying power to the electrical buses, as during ground maintenance, contacts of the No. 1 external power relay close and power is supplied to energize the waste water mast heater external power control relay. If for any reason the ground control relays should be deenergized, 28-vdc continues to be supplied to the mast heater control switch through the energized heater external power control relay.



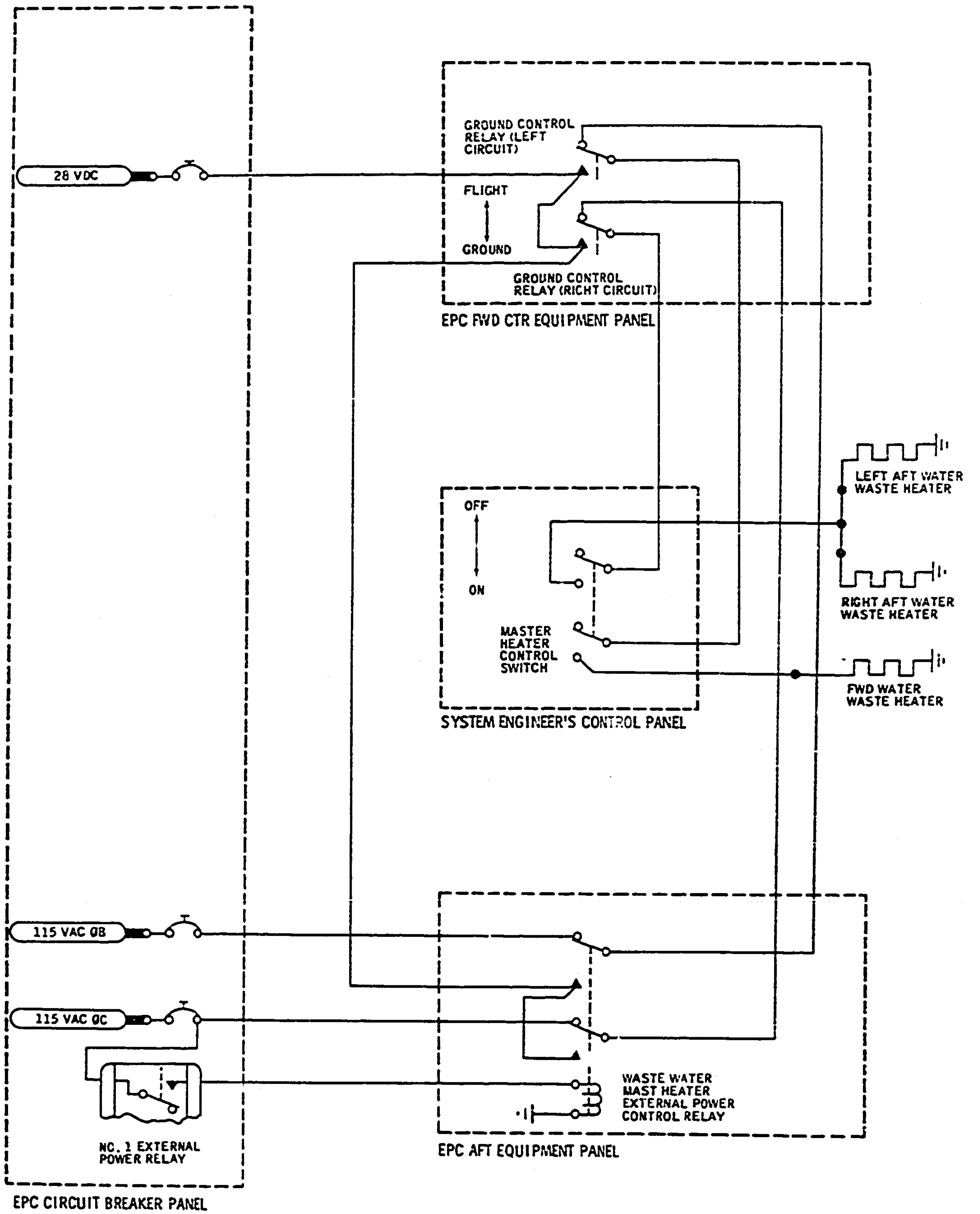
Potable Water System Service Panel Heater -- Electrical Schematic
Figure 1

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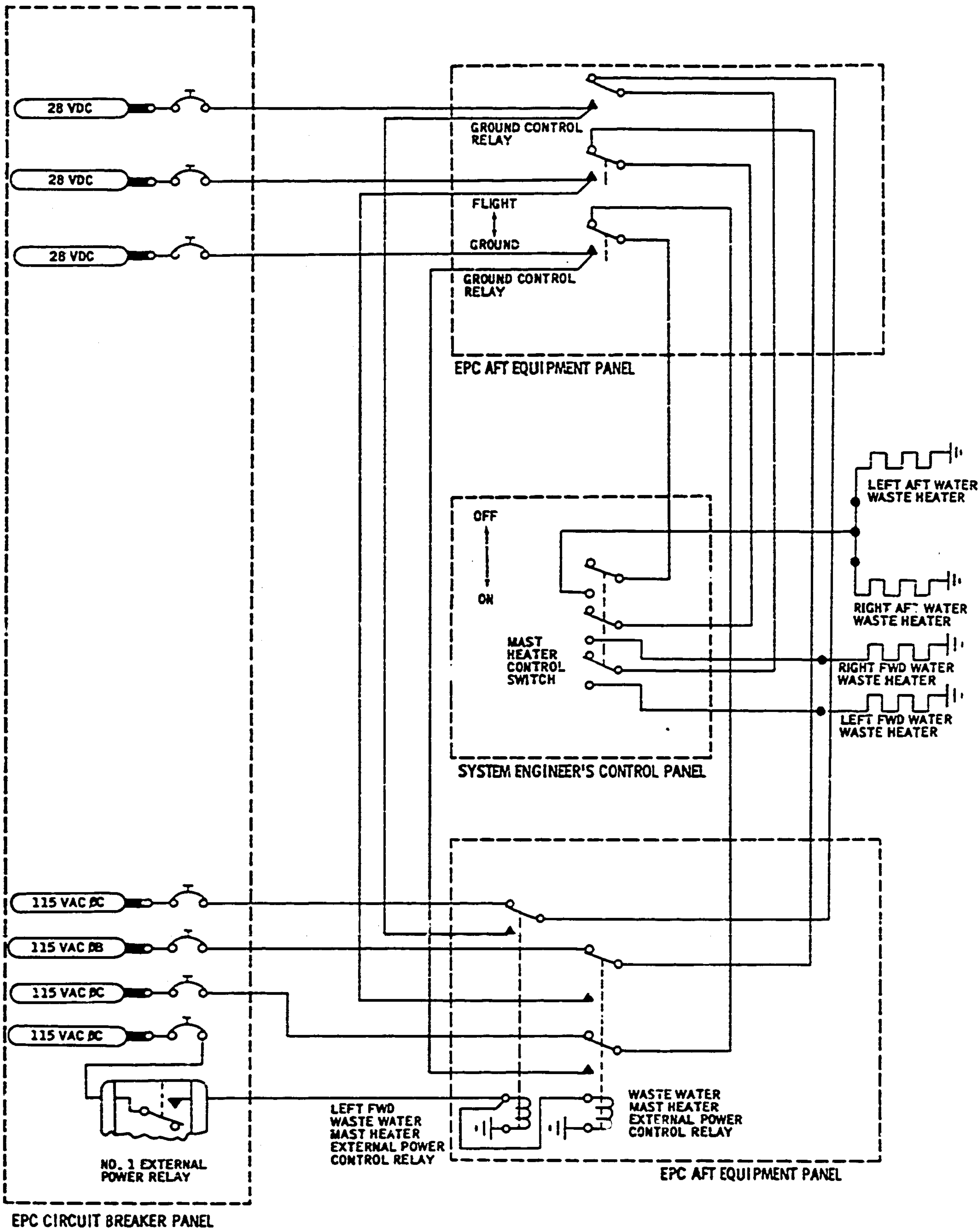


HA2-2673

Waste Water Drain Mast Heaters -- Electrical Schematic
(Airplanes 70, 71)
Figure 2 (Sheet 1)



Waste Water Drain Mast Heaters -- Electrical Schematic
(Airplanes 72, 73)
Figure 2 (Sheet 2)



HA2-6.71

Waste Water Drain Mast Heaters -- Electrical Schematic
(Airplane 74)
Figure 2 (Sheet 3)

WATER LINES - DESCRIPTION AND OPERATION

1. General

A. Ice protection of the water lines consist of a heating element in each forward, center, and aft waste water drain mast.

2. Description

A. The waste water drain mast heaters consist of a tube containing a resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

3. Operation (Airplanes 860-866)

A. The waste water drain mast heaters operate on 115-vac power when in flight, and on 28-volt power when on the ground. This provides a high heat range in flight and a low heat range on the ground.

B. When in flight, the nose oleo shift mechanism opens the ground control relays, closing the contacts between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast heaters.

C. When on the ground, the nose oleo shift mechanism closes the ground relays, closing the contacts between the 28-vdc water waste circuit breaker and the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

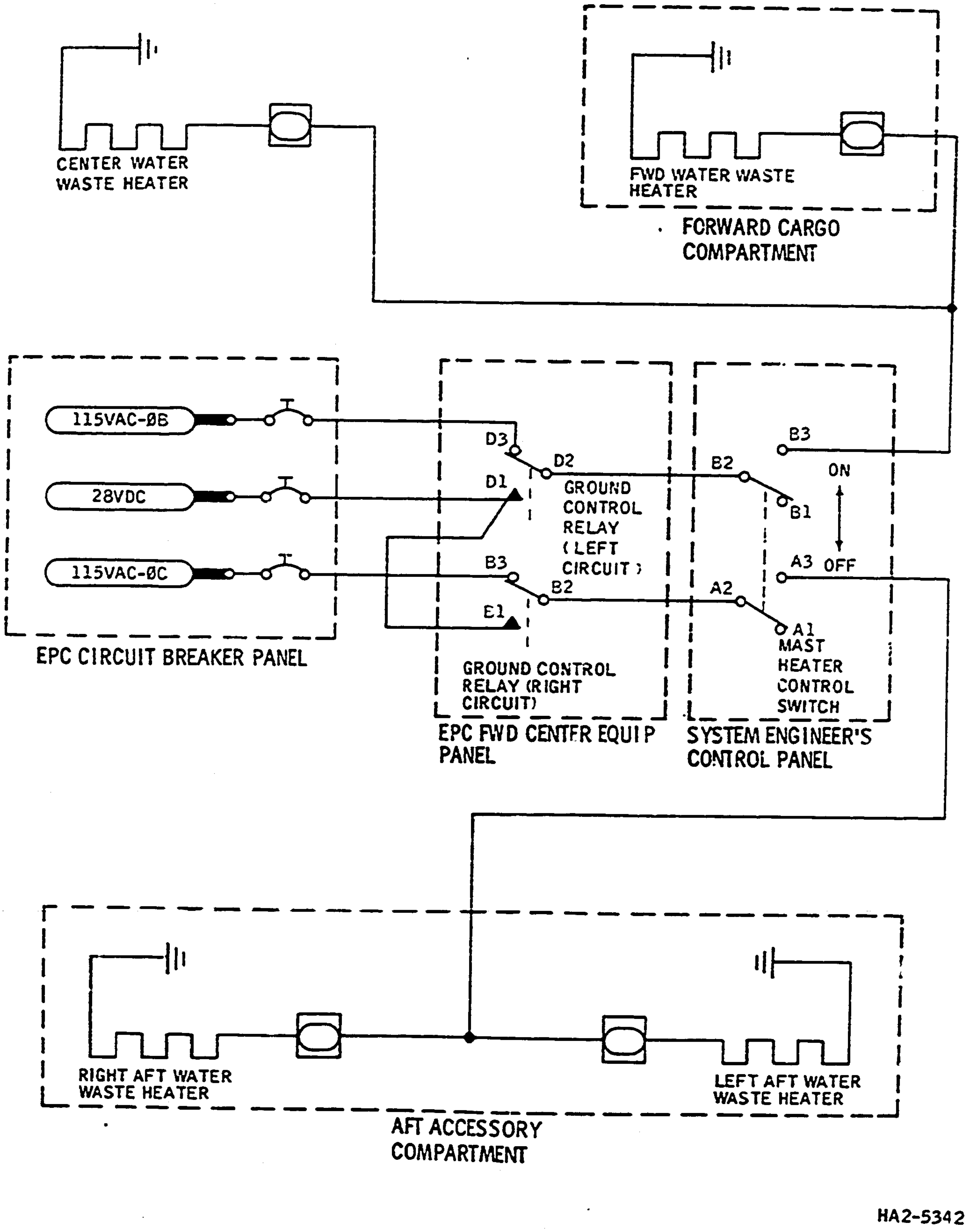
4. Operation (Airplanes 867 and Subsequent)

A. The waste water drain mast heaters operate on 115-vac power when in flight and on 28-volt when on the ground. This provides a high heat range in flight and a low heat range on the ground.

B. With the airplane generator system supplying power to the electrical buses and the airplane on the ground (strut compressed) the nose gear oleo ground shift mechanism causes the ground control relays to energize. Contacts of the relay close and 28-vdc power is supplied to the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

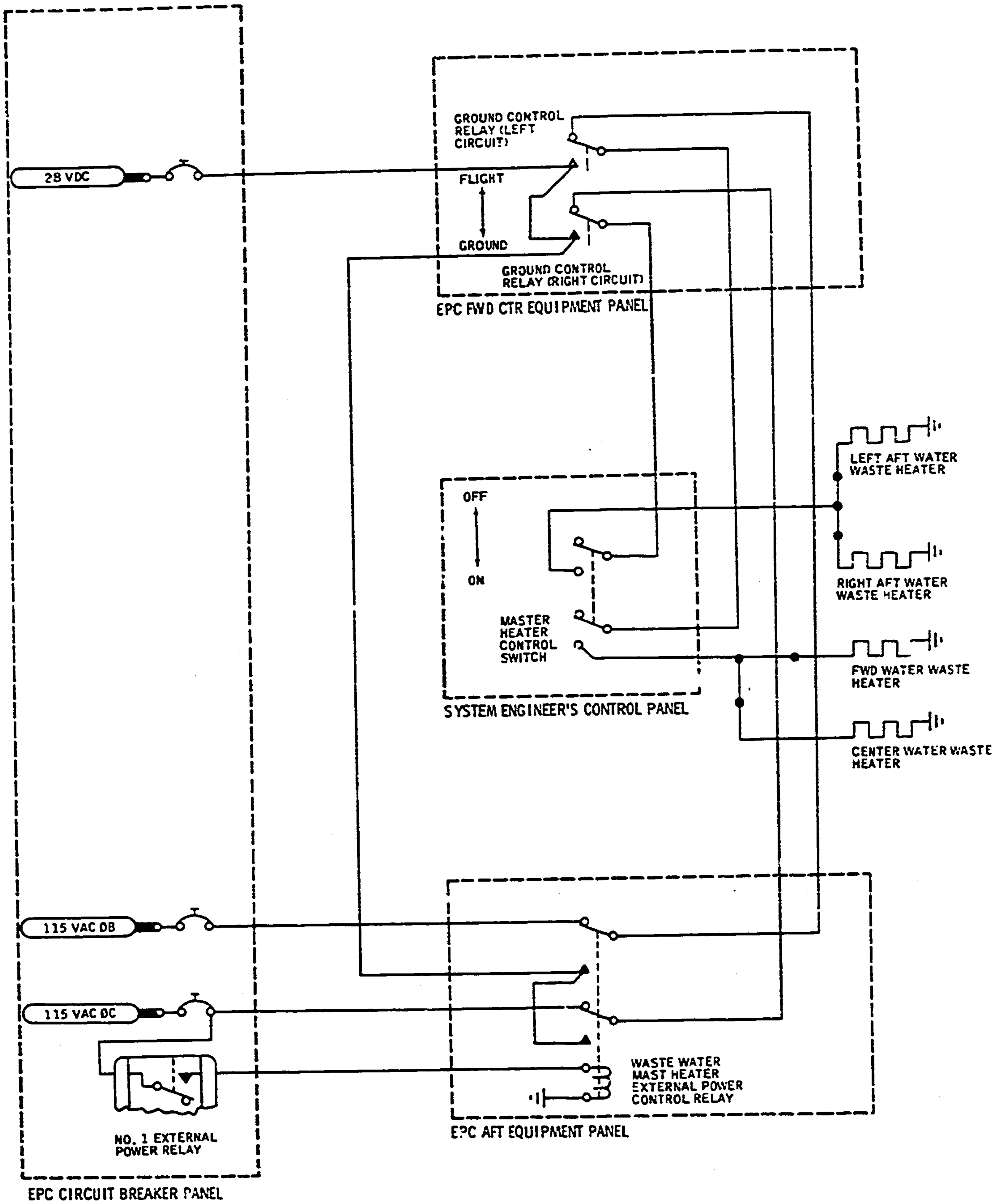
C. When external electrical power is supplying power to the electrical buses, as during ground maintenance, an interlock circuit prevents 115-vac inadvertently being supplied to the mast heater control switch. With external power applied to the airplane, contacts of the No. 1 external power relay close and power is supplied to energize the waste water mast heater external control relay. If for any reason the ground control relays should be deenergized, 28-vdc continues to be supplied to the mast heater control switch through the energized heater external power control relay.

D. When the airplane is in a flight position (strut extended) the nose gear oleo ground shift mechanism causes the ground control relays to deenergize. Contacts of the ground control relays open the 28-vdc circuit and close the circuit between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast heaters.

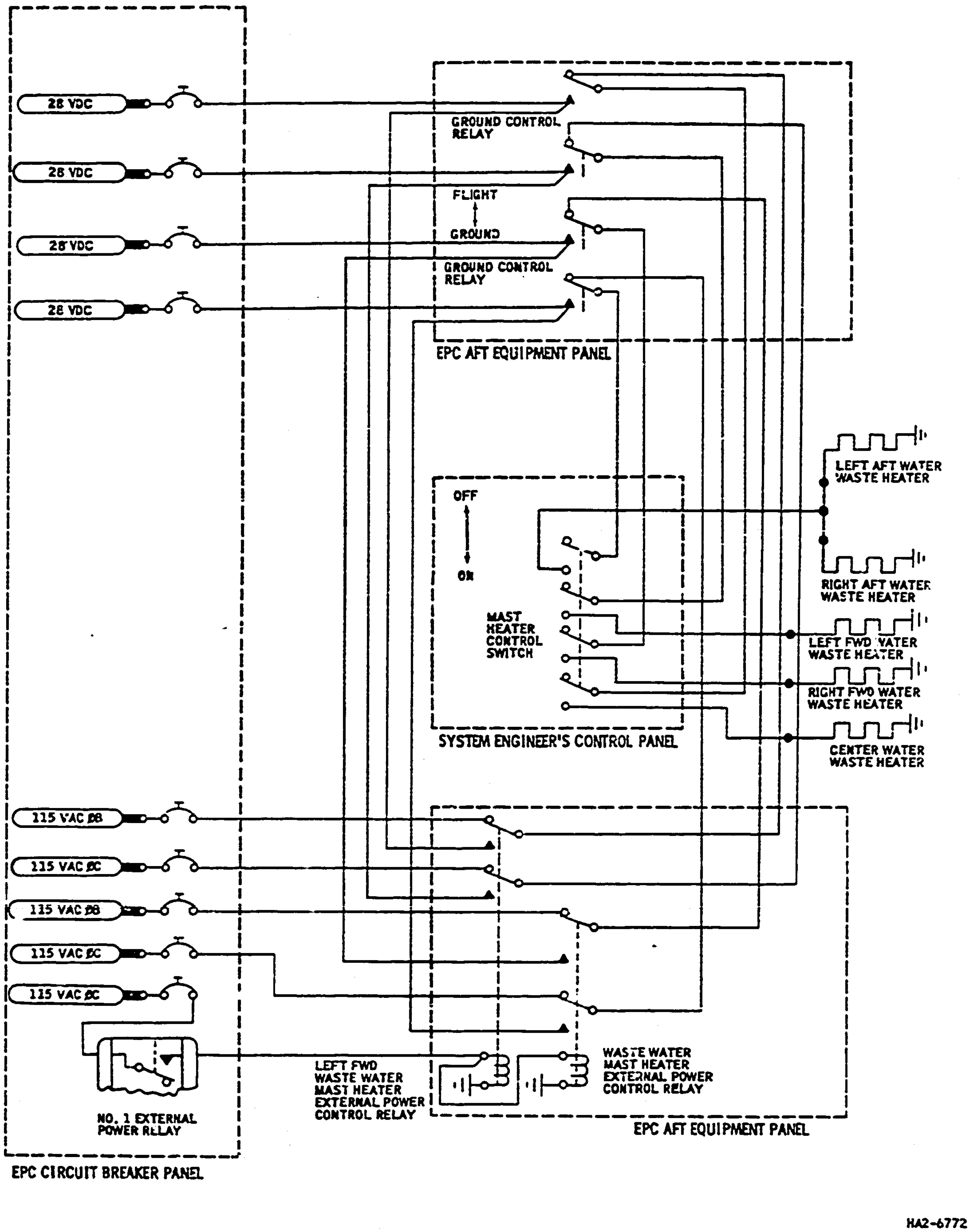


Waste Water Drain Mast Heaters -- Electrical Schematics
(Airplanes 860-866)
Figure 1 (Sheet 1)

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Waste Water Drain Mast Heaters -- Electrical Schematic
(Airplanes 867 - 873)
Figure 1 (Sheet 2)



Waste Water Drain Mast Heaters -- Electrical Schematic
(Airplanes 874 and Subsequent)
Figure 1 (Sheet 3)

WATER LINES - DESCRIPTION AND OPERATION

1. General

   A. Ice protection of the water lines consists of a heating element on the potable water system service panel, a heating element on the potable water system drain fitting, and a heating element in each forward, center, and aft waste water drain mast.

2. Description

   A. The service panel heating elements are fabricated assemblies consisting of a formed brass pan with a circular, rod-type resistance heating element brazed to the pan near its outer flange. The element operates on 115-volt, 400-cycle, ac power and is rated at 50 watts. Screw-type electrical terminals, one connected to each end of the element rod, and a temperature sensitive control switch are located between the ends of the element and are insulated with a moulded rubber sheath. The terminals provide connections to the airplane electrical system. The center area of the base pan incorporates two holes where the water connection nipples pass through the pan. Gaskets around the nipples and under the base pan retain fuselage pressurization while nuts on the nipples secure the heater to the fiberglass service panel plate. A hard-rubber abrasion ring is installed between the edge of the heating element base pan and the fiberglass plate to prevent the edge of the pan from cutting the plate.

   B. The waste water drain mast heaters consist of a tube containing a resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

3. Operation (Airplanes Without Service Bulletin 30-27 Incorporated)

   A. The potable water system service panel heater and potable water system drain fitting heater operate from the 115-vac cabin bus 4 through the water service panel heater circuit breaker (see Figure 1). Heater operation is automatic when the circuit breaker is closed and the bus is energized. The service panel heater heats the area around the fill and overflow fittings located on the service panel. Electrical power to the heating element is controlled by the temperature sensitive switch which closes at approximately 65°F (18.3°C). The drain fitting heater heats the area around the drain fitting. Electrical power is continuously supplied to the heater element with the circuit breaker closed and the bus energized.

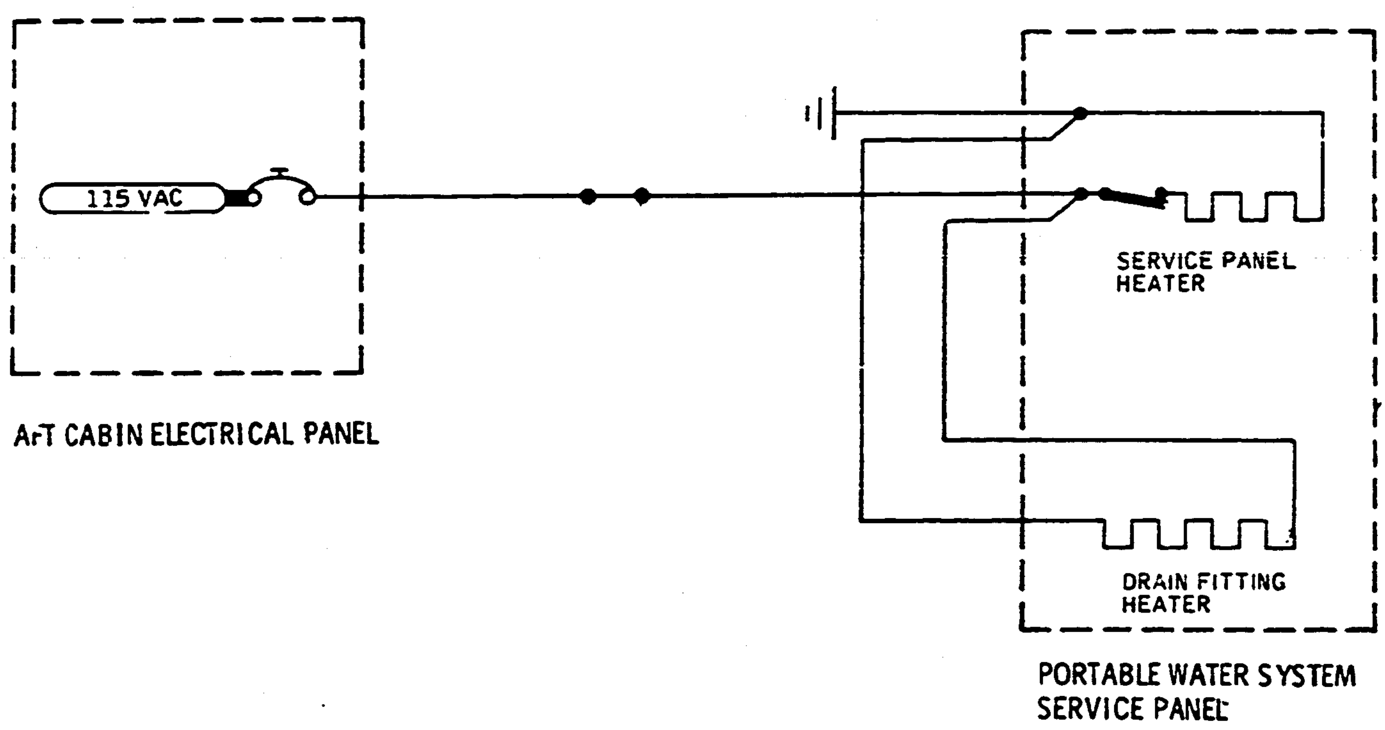
B. The waste water drain mast heaters operate on 115-vac power when in flight, and on 28-volt power when on the ground (see Figure 2). This provides a high heat range in flight and a low heat range on the ground.

C. When in flight, the nose oleo shift mechanism opens the ground control relays, closing the contacts between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast heaters.

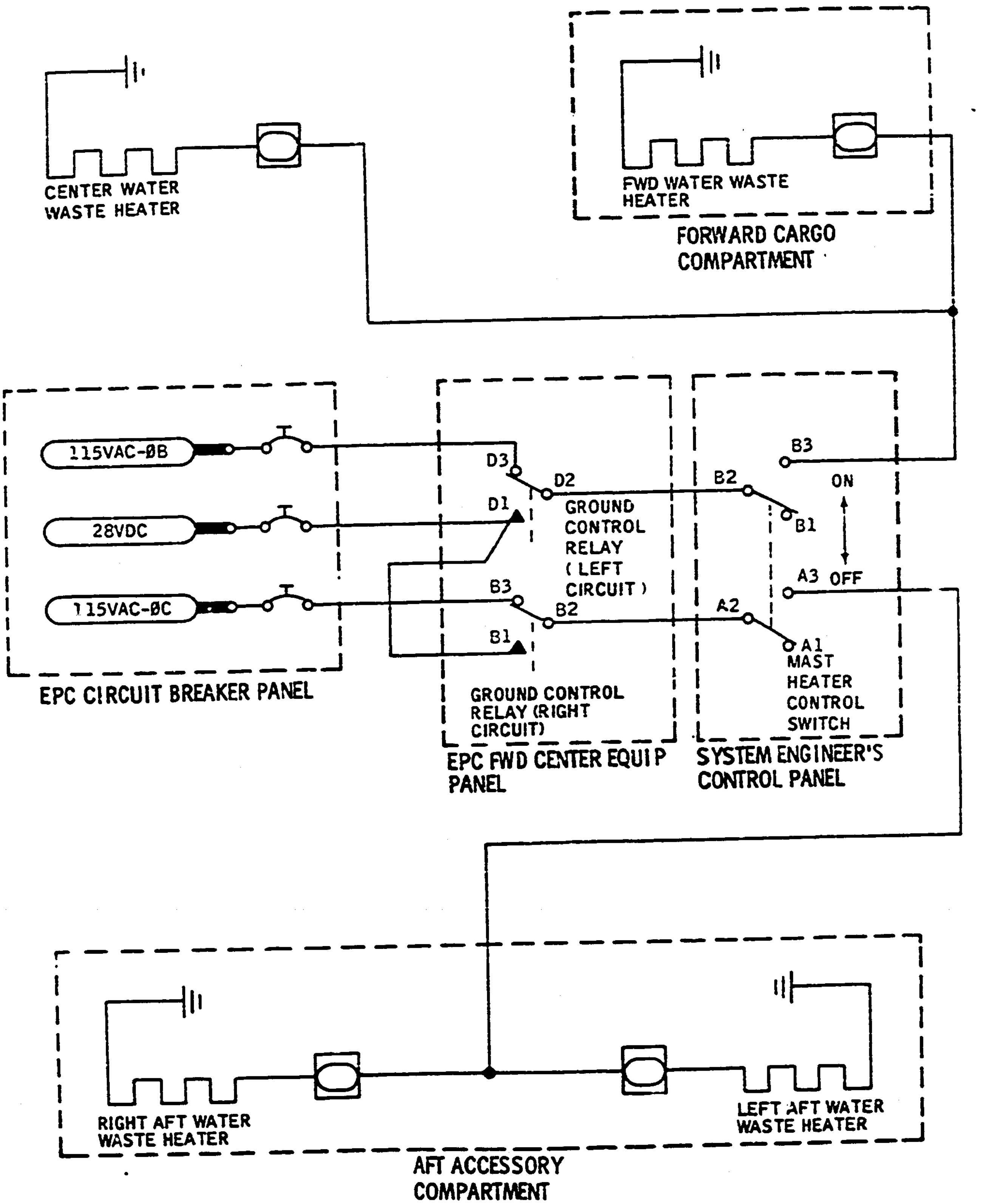
D. When on the ground, the nose oleo shift mechanism closes the ground relays, closing the contacts between the 28-vdc water waste circuit breaker and the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

4. Operation (Airplanes With Service Bulletin 30-27 Incorporated)

A. The potable water system service panel heater and potable water system drain fitting heater operate from the 115-vac cabin bus 4 through the water service panel heater circuit breaker (see Figure 1). Heater operation is automatic when the circuit breaker is closed and the bus is energized. The service panel heater heats the area around the fill and overflow fittings located on the service panel. Electrical power to the heating element is controlled by the temperature sensitive switch which closes at approximately 65°F (18.3°C). The drain fitting heater heats the area around the drain fitting. Electrical power is continuously supplied to the heater element with the circuit breaker closed and the bus energized.

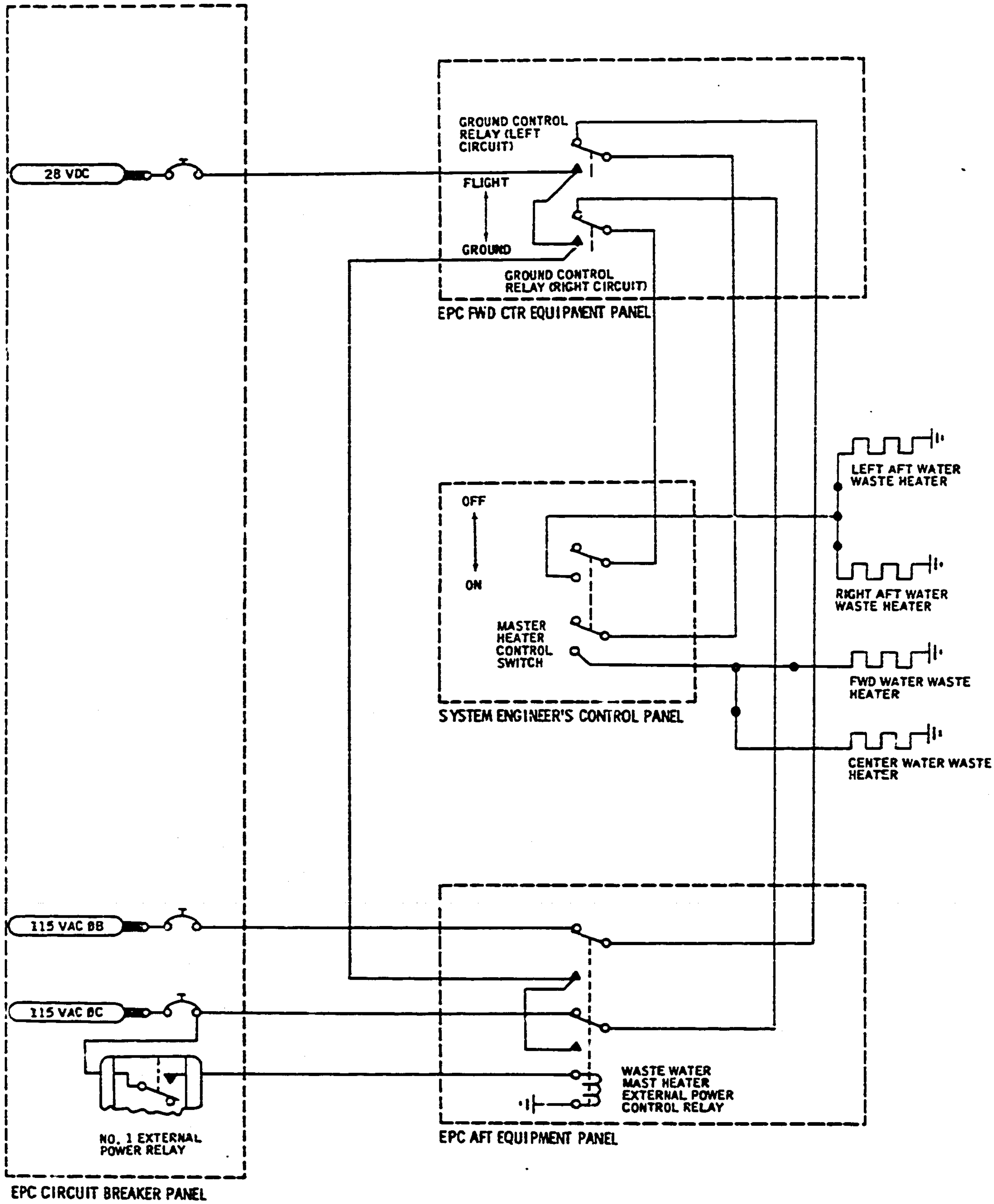


Potable Water System Service Panel Heater -- Electrical Schematic
Figure 1



HA2-5342

Waste Water Drain Mast Heaters -- Electrical Schematics
(Airplanes Without Service Bulletin 30-27 Incorporated)
Figure 2 (Sheet 1)



Waste Water Drain Mast Heaters -- Electrical Schematic
(Airplanes With Service Bulletin 30-27 Incorporated)
(Airplanes 867 - 873)
Figure 2 (Sheet 2)

B. The waste water drain mast heaters operate on 115-vac power when in flight and on 28-volt when on the ground. This provides a high heat range in flight and a low heat range on the ground.

C. With the airplane generator system supplying power to the electrical buses and the airplane on the ground (strut compressed) the nose gear oleo ground shift mechanism causes the ground control relays to energize. Contacts of the relay close and 28-vdc power is supplied to the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

D. When external electrical power is supplying power to the electrical buses, as during ground maintenance, an interlock circuit prevents 115-vac inadvertently being supplied to the mast heater control switch. With external power applied to the airplane, contacts of the No. 1 external power relay close and power is supplied to energize the waste water mast heater external control relay. If for any reason the ground control relays should be deenergized, 28-vdc continues to be supplied to the mast heater control switch through the energized heater external power control relay.

E. When the airplane is in a flight position (strut extended) the nose gear oleo ground shift mechanism causes the ground control relays to deenergize. Contacts of the ground control relays open the 28-vdc circuit and close the circuit between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast heaters.

WATER LINES - DESCRIPTION AND OPERATION

1. General

A. Ice protection of the water lines consist of a heating element in each forward and aft waste water drain masts.

2. Description

A. The waste water drain mast heaters consists of a tube containing a resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

3. Operation

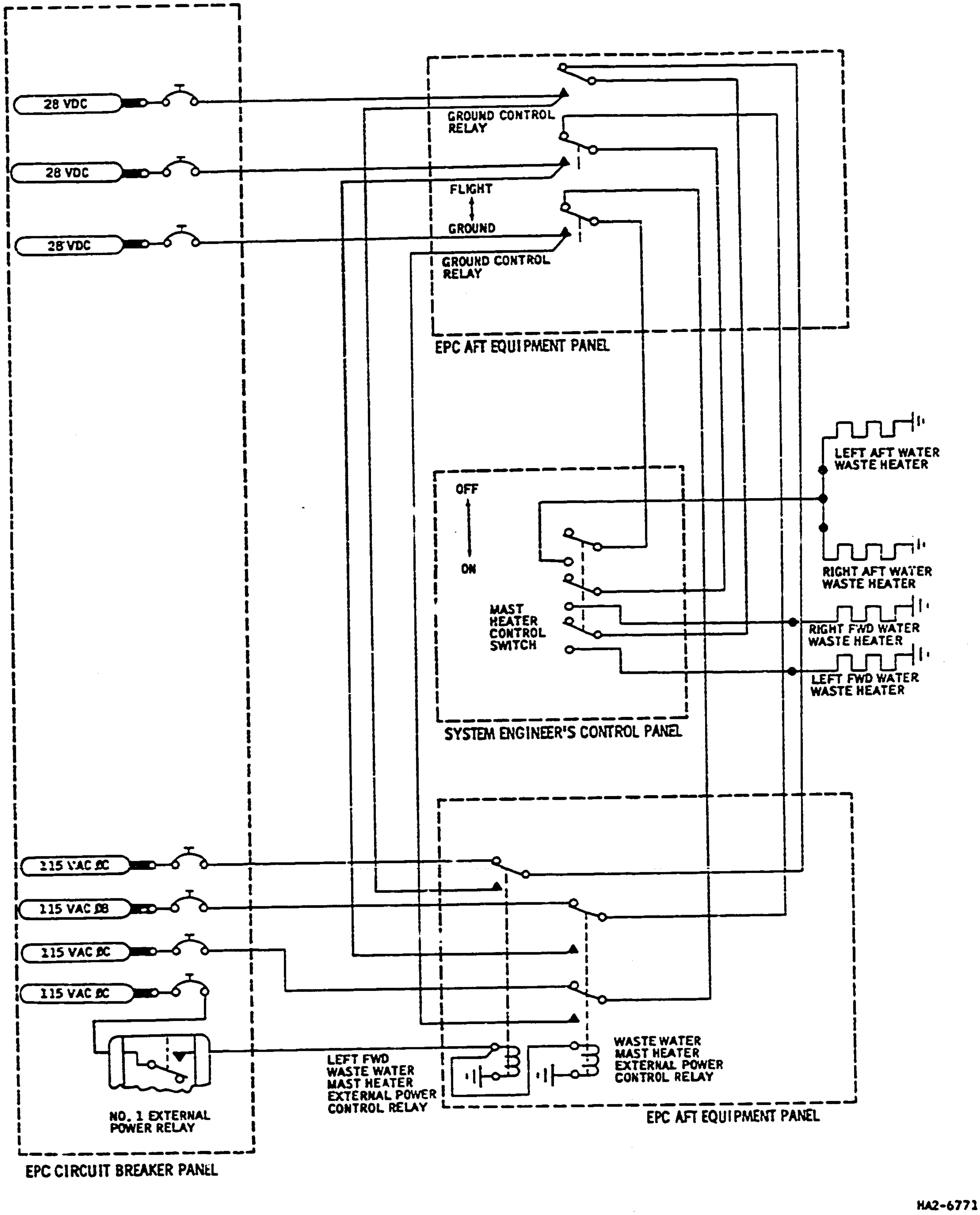
A. The waste water drain mast heaters operate on 115-vac power when in flight and on 28 volt when on the ground. This provides a high heat range in flight and a low heat range on the ground.

B. With the airplane generator system supplying power to the electrical buses and the airplane on the ground (strut compressed) the nose gear oleo ground shift mechanism cause the ground control relays to energize. Contacts of the relay close and 28-vdc power is supplied to the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

C. When external electrical power is supplying power to the electrical buses, as during ground maintenance, an interlock circuit prevents 115-vac inadvertently being supplied to the mast heater control switch. With external power applied to the airplane, contacts of the No. 1 external power relay close and power is supplied to energize the waste water mast heater external control relay. If for any reason the ground control relays should be deenergized, 28-vdc continues to be supplied to the mast heater control switch through the energized heater external power control relay.

D. When the airplane is in a flight position (strut extended) the nose gear oleo ground shift mechanism cause the ground control relays to deenergize. Contacts of the ground control relays open the 28-vdc circuit and close the circuit between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast heaters.

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Waste Water Drain Mast Heaters -- Electrical Schematic
Figure 1

WATER LINES - DESCRIPTION AND OPERATION

1. General

A. Ice protection of the water lines consists of a heating element on the potable water system service panel, a heating element on the potable water system drain fitting, and a heating element in each forward and aft waste water drain mast.

2. Description

A. There are two types of heaters used on the potable water system service panel. The first type surrounds the fill and overflow fittings and is a fabricated assembly consisting of a formed brass pan with a circular, rod-type resistance heating element brazed to the pan near its outer flange. The element operates on 115-volt, 400-cycle, ac power and is rated at 50 watts. Screw-type electrical terminals, one connected to each end of the element rod, and a temperature sensitive control switch are located between the ends of the element and are insulated with a molded rubber sheath. The terminals provide connections to the airplane electrical system. The center area of the base pan incorporates two holes where the water connection nipples pass through the service panel plate. A hard-rubber abrasion ring is installed between the edge of the heating element base pan and the fiberglass plate to prevent the edge of the pan from cutting the plate.

B. The second type of heater surrounds the drain fitting and is a molded assembly of silicone rubber consisting of a resistance-type heating element and necessary electrical wiring for connecting to the airplane electrical system. The heater is rated at 8 watts at 115-vac.

C. The waste water drain mast heaters consist of a tube containing resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

3. Operation

A. The potable water system service panel heater and potable water system drain fitting heater operate from the 115-vac cabin bus through the water service panel heater circuit breaker (see Figure 1). Heater operation is automatic when the circuit breaker is closed and the bus is energized. The service panel heater heats the area around the fill and overflow fittings located on the service panel. Electrical power to the heating element is controlled by the temperature sensitive switch which closes at approximately 65°F (18.3°C). The drain fitting heater heats the area around the drain

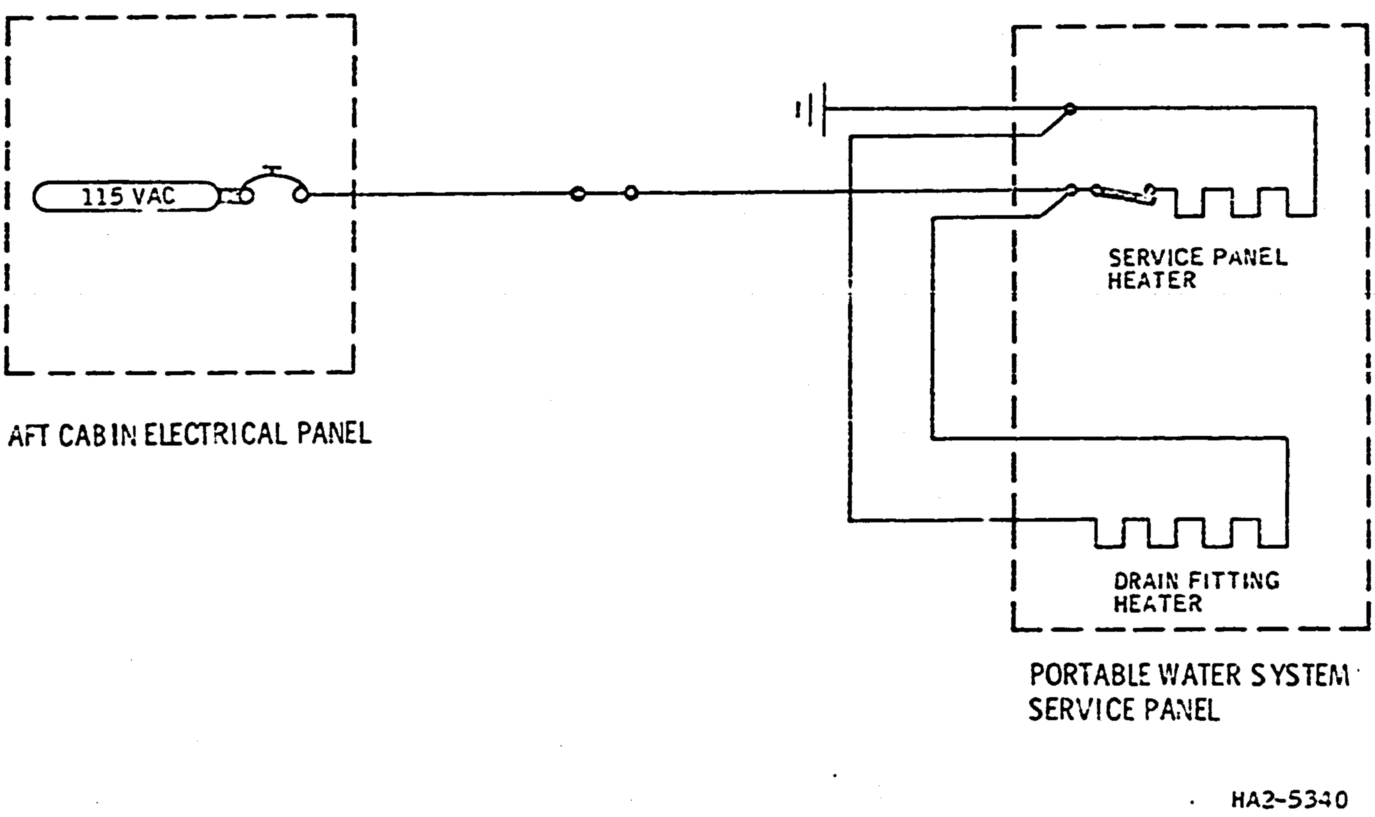
fitting. Electrical power is continuously supplied to the heater element with the circuit breaker closed and the bus energized.

B. The waste water drain mast heaters operate on 115-vac power when in flight, and on 28-volt power when on the ground (see Figure 2). This provides a high heat range in flight and a low heat range on the ground.

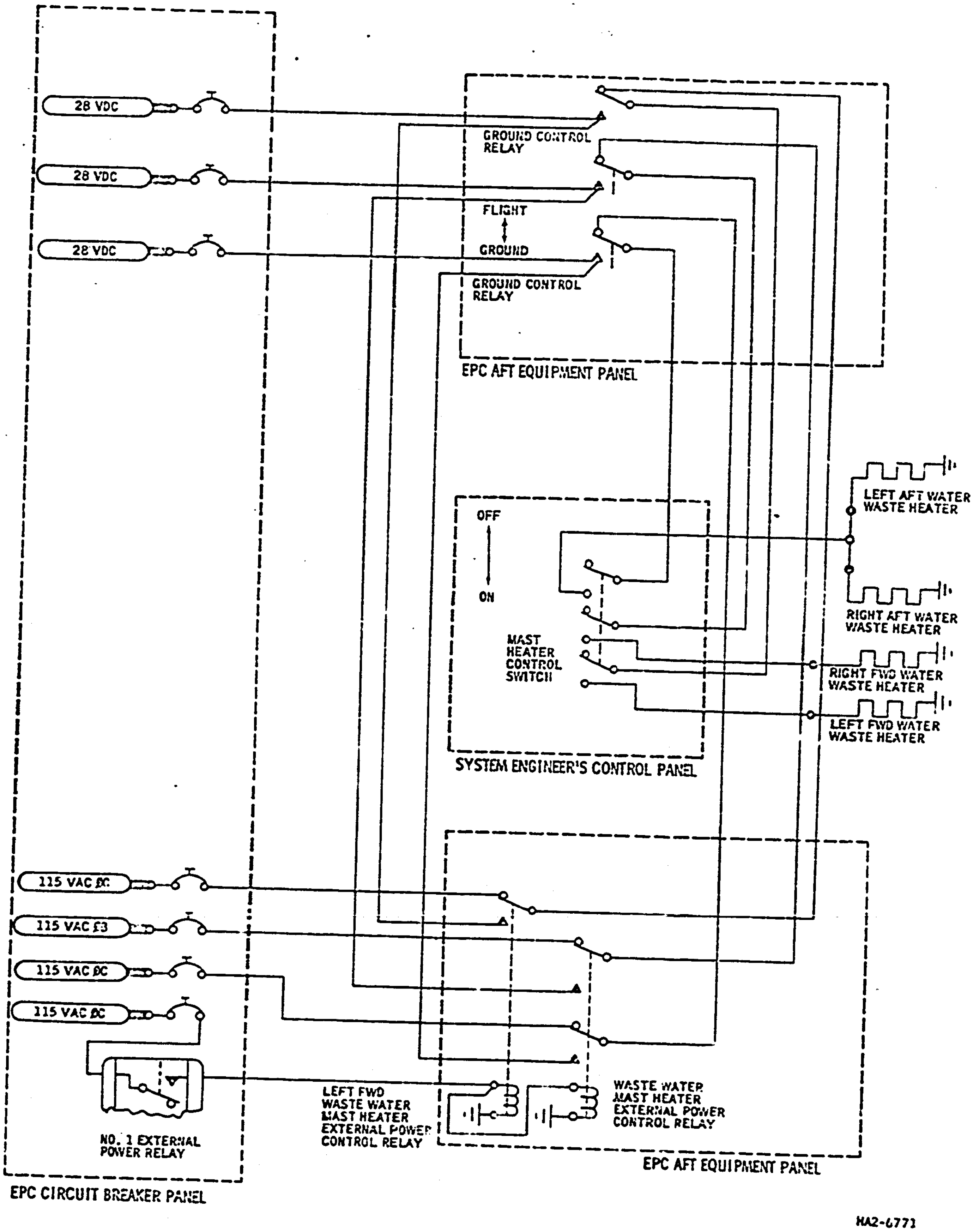
C. When the airplane is in a flight position (strut extended) the nose gear oleo ground shift mechanism cause the ground control relays to deenergize. Contacts of the ground control relays open the 28-vdc circuit and close the circuit between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast heaters.

D. With the airplane on the ground (strut compressed) the nose gear oleo ground shift mechanism cause the ground control relays to energize. Contacts of the relay close and 28-vdc is supplied to the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

E. An interlock circuit prevents 115-vac external electrical power inadvertently being supplied to the mast heater control switch. When external electrical power is supplying power to the electrical buses, as during ground maintenance, contacts of the No. 1 external power relay close and power is supplied to energize the waste water mast heater external power control relay. If for any reason the ground control relays should be deenergized, 28-vdc continues to be supplied to the mast heater control switch through the energized heater external power control relay.



Potable Water System Service Panel Heater --
Electrical Schematic
Figure 1



Waste Water Drain Mast Heaters --
Electrical Schematic
Figure 2

WATER LINES - DESCRIPTION AND OPERATION

1. General

A. Ice protection of the water lines consist of a heating element in both forward waste water drain masts.

2. Description

A. The waste water drain mast heater consists of a tube containing a resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

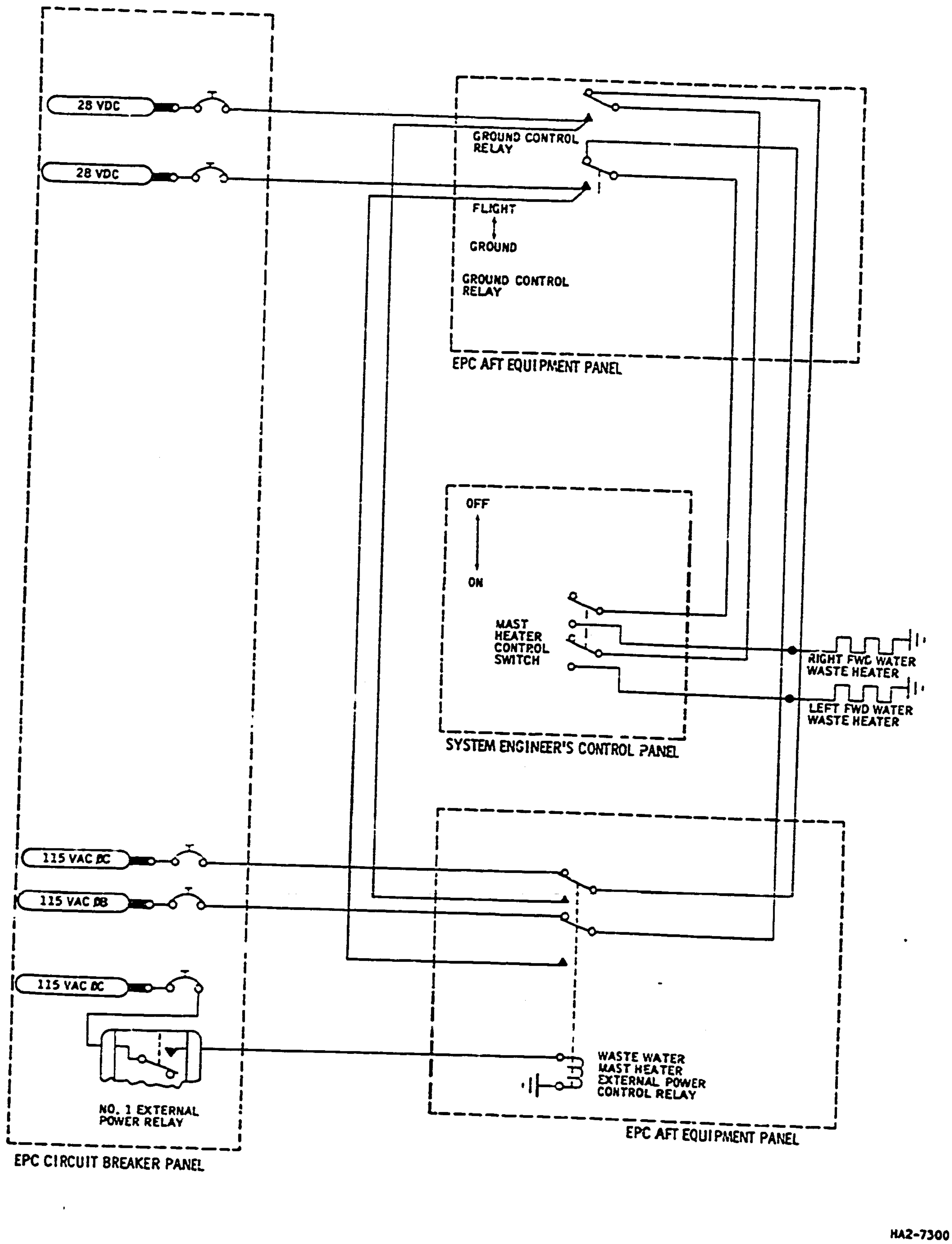
3. Operation

A. The waste water drain mast heaters operate on 115-vac power when in flight and on 28-volt when on the ground. This provides a high heat range in flight and a low heat range on the ground.

B. With the airplane generator system supplying power to the electrical buses and the airplane on the ground (strut compressed) the nose gear oleo ground shift mechanism causes the ground control relays to energize. Contacts of the relay close and 28-vdc power is supplied to the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

C. When external electrical power is supplying power to the electrical buses, as during ground maintenance, an interlock circuit prevents 115-vac inadvertently being supplied to the mast heater control switch. With external power applied to the airplane, contacts of the No. 1 external power relay close and power is supplied to energize the waste water mast heater external control relay. If for any reason the ground control relays should be deenergized, 28-vdc continues to be supplied to the mast heater control switch through the energized heater external power control relay.

D. When the airplane is in a flight position (strut extended) the nose gear oleo ground shift mechanism causes the ground control relays to deenergize. Contacts of the ground control relays open the 28-vdc circuit and close the circuit between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast heaters.



Waste Water Drain Mast Heaters -- Electrical Schematic
Figure 1

WATER LINES - DESCRIPTION AND OPERATION

1. General

A. Ice protection of the water lines consists of a heating element on the potable water system service panel and a heating element in each forward and aft waste water drain mast.

2. Description

A. The service panel heating element is a fabricated assembly consisting of a formed brass pan with a circular, rod-type resistance heating element brazed to the pan near its outer flange. The element operates on 115-volt, 400-cycle, ac power and is rated at 50 watts. Screw-type electrical terminals, one connected to each end of the element rod, and a temperature sensitive control switch are located between the ends of the element and are insulated with a moulded rubber sheath. The terminals provide connections to the airplane electrical system. The center area of the base pan incorporates two holes where the water connection nipples pass through the pan. Gaskets around the nipples and under the base pan retain fuselage pressurization while nuts on the nipples secure the heater to the fiberglas service panel plate. A hard-rubber abrasion ring is installed between the edge of the heating element base pan and the fiberglas plate to prevent the edge of the pan from cutting the plate.

B. The waste water drain mast heaters consist of a tube containing a resistance-type heating element. The tubular element extends from the top of the mast, where the drain piping is connected, to the lower aft end of the mast where it is terminated with a molded, open-centered cap. The heater forms the drain passage, while the mast provides a streamlined fairing and structural support. Electrical terminals are provided at the upper end of the heating element.

3. Operation

A. The potable water system service panel heater operates from the 115-vac cabin bus 4 through the water service panel heater circuit breaker (see Figure 1). The temperature sensitive switch, located on the heater, element provides thermostatic control. Heater operation is automatic when the circuit breaker is closed and the cabin bus 4 is energized.

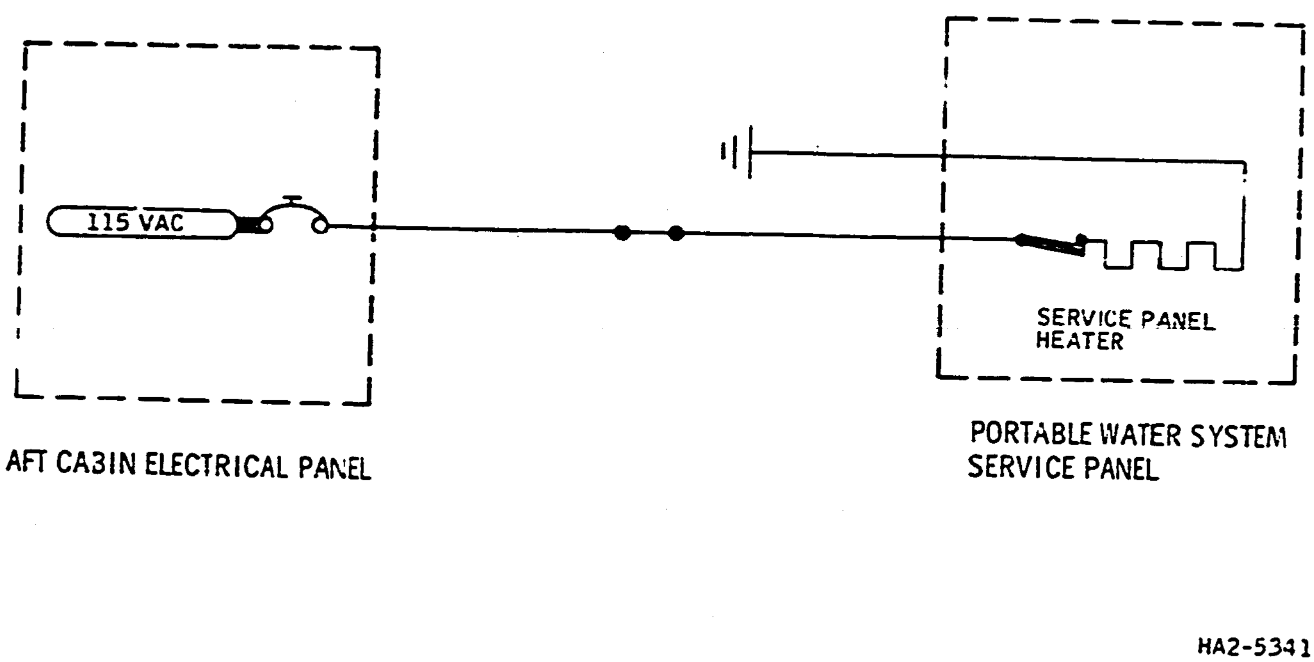
B. The waste water drain mast heaters operate on 115-vac power when in flight, and on 28-volt power when on the ground (see Figure 2). This provides a high heat range in flight and a low heat range on the ground.

C. With the airplane generator system supplying power to the electrical buses and the airplane on the ground (strut compressed) the nose gear oleo ground shift mechanism causes the ground control relays to energize.

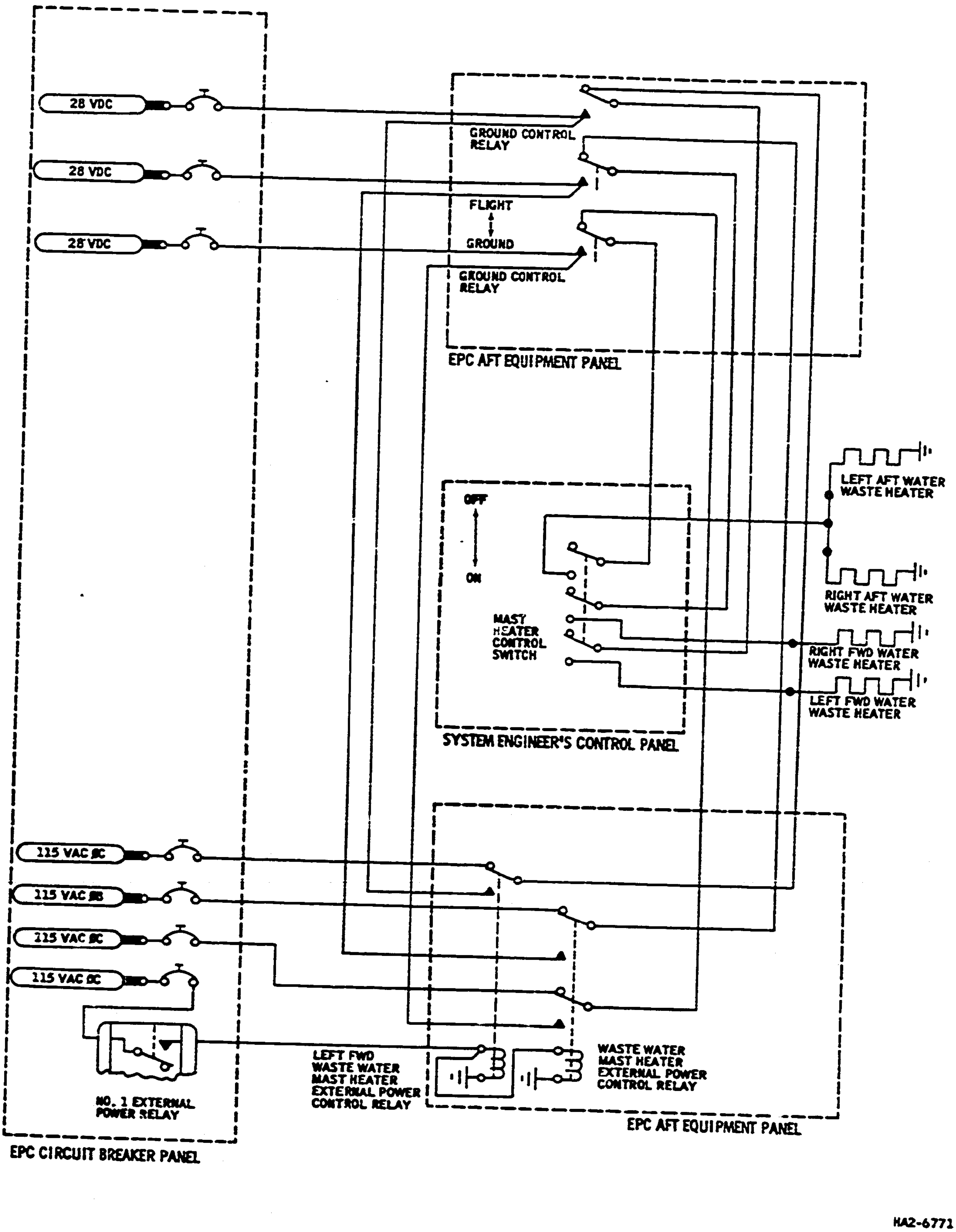
Contacts of the relay close and 28-vdc power is supplied to the mast heater control switch. When the switch is placed in the on position, 28-vdc (low range heat) is supplied to the waste water drain mast heaters.

D. When external electrical power is supplying power to the electrical buses, as during ground maintenance, and interlock circuit prevents 115-vac from inadvertently being supplied to the mast heater control switch. With external power applied to the airplane, contacts of the No. 1 external power relay close and power is supplied to energize the waste water mast heater external control relay. If for any reason the ground control relays should be deenergized, 28-vdc continues to be supplied to the mast heater control switch through the energized heater external power control relay.

E. When the airplane is in a flight position (strut extended) the nose gear oleo ground shift mechanism causes the ground control relays to deenergize. Contacts of the ground control relays open the 28-vdc circuit and close the circuit between the 115-vac water waste circuit breakers and the mast heater control switch. When the switch is placed in the on position, 115-vac (high range heat) is supplied to the waste water drain mast breakers.



Potable Water System Service Panel Heater --
Electrical Schematic
Figure 1



Waste Water Drain Mast Heaters -- Electrical Schematic
Figure 2

WATER LINES - TROUBLE SHOOTING

1. General

A. The waste water drain mast heaters are located on the bottom of the fuselage, one between the wing and forward passenger entrance door, and two located just forward of the tail skid to the left and right of the fuselage centerline. Access to the piping and heater electrical connections for the forward drain mast is through the forward lower cargo compartment. Access to the aft drain mast heaters is through the aft accessory compartment. Trouble shooting procedures for the aft waste water drain masts are identical.

2. Tools and Equipment Required

A. A multimeter is used to test the applicable circuits for continuity.

3. Trouble Shooting Forward Waste Water Drain Mast Heater

Possible Causes	Isolation Procedure	Correction
A. FORWARD WASTE WATER DRAIN MAST HEATER INOPERATIVE		
(1) Defective heating element	Check for 28-vac between terminal strip and ground.	If voltage exists, replace heating element.
(2) Defective wiring	With water waste heater circuit breakers open and mast heater control switch open, check for continuity between No. 1 miscellaneous ground control relay and terminal strip.	If continuity does not exist, repair or replace wiring (see Wire Diagram Manual).
B. AFT WASTE WATER DRAIN MAST HEATER INOPERATIVE		
(1) Defective	Check for 28-vac between terminal strip and ground.	If voltage exists, replace heating element.

Possible Causes	Isolation Procedure	Correction
B. AFT WASTE WATER DRAIN MAST HEATER INOPERATIVE (Continued)		
(2) Defective wiring	With water waste heater circuit breakers open and mast heater control switch open, check for continuity between right air conditioning system ground control relay and terminal strip.	If continuity does not exist, repair or replace wiring (see Wire Diagram Manual).

WATER LINES - TROUBLE SHOOTING

1. General

A. The waste water drain masts are located on the bottom exterior of the airplane and in the approximate fuselage areas of the lavatories and galleys.

B. If the waste water drain masts require frequent replacement due to a defective heating element (possible overheating), the waste water mast heater external power control relay should be suspected as being faulty. Test procedures accomplished on various systems during ground maintenance require that flight conditions be simulated by operation of the nose gear ground shift mechanism or opening the ground control relays circuit breakers. The mast heater external power control relay is provided to ensure that with external electrical power supplied to the electrical buses, only 28-vdc is applied to the mast heater elements regardless of ground control relays operation. If the waste water mast heater external power control relay is not energized when flight conditions are simulated; 115-vac is applied to the mast heater elements.

C. 28-vdc or 115-vac to the aft waste water drain mast heaters is controlled through a relay in the right ground control relays circuit (see Wiring Diagram Manual). Power to the forward heater is controlled through a relay of the left ground control relays circuit.

2. Tools and Equipment Required

A. A multimeter, Simpson Model 260, or equivalent, is required for voltage and continuity checks.

3. Trouble Shooting Water Lines Ice Protection Heaters

Possible Causes	Isolation Procedure	Correction
A. WASTE WATER DRAIN MAST HEATER INOPERATIVE		
(1) Defective heating element	With airplane on ground, external electrical power applied to all buses, and mast heater control switch in on position, check for 28-vdc at heater terminal strip.	If 28-vdc exists, replace waste water mast. If no voltage exists, proceed to (2).

Possible Causes	Isolation Procedure	Correction
A. WASTE WATER DRAIN MAST HEATER INOPERATIVE (Continued)		
(2) Defective wiring or mast heater control switch	Open water waste heaters circuit breaker (28-vdc). Check continuity between applicable ground control relay and heater terminal strip (see Wiring Diagram Manual).	If no continuity, repair wiring or replace switch as required.
B. POTABLE WATER SYSTEM SERVICE PANEL HEATER INOPERATIVE BELOW AMBIENT TEMPERATURE OF 65 (±10)°F (18.3 (±5.6)°C).		
(1) Defective heating element	Check for 115-vac at heater terminal.	If voltage exists, replace heater.
(2) Defective wiring	Open water service panel heater circuit breaker. Check continuity of wiring between circuit breaker and heater terminal and between heater and ground (see Wiring Diagram Manual).	Repair or replace wiring as required.

WATER LINES - TROUBLE SHOOTING

1. General

A. The waste water drain mast heaters are located on the bottom of the fuselage, one between the wing and forward passenger entrance door, and two located just forward of the tail skid to the left and right of the fuselage centerline. Access to the piping and heater electrical connections for the forward drain mast is through the forward lower cargo compartment. Access to the aft drain mast heaters is through the aft accessory compartment. Trouble shooting procedures for the aft waste water drain masts are identical.

2. Tools and Equipment Required

A. A multimeter is used to test the applicable circuit for continuity.

3. Trouble Shooting Forward Waste Water Drain Mast Heater

	Possible Causes	Isolation Procedure	Correction
A.	FORWARD WASTE WATER DRAIN MAST HEATER INOPERATIVE		
(1)	Defective heating element	Check for 28-vac between terminal strip and ground.	If voltage exists, replace heating element.
(2)	Defective wiring	With water waste heater circuit breakers open and mast heater control switch open, check for continuity between ground control relay and terminal strip.	If continuity does not exist, repair or replace wiring (see Wire Diagram Manual).
B.	AFT WASTE WATER DRAIN MAST HEATER INOPERATIVE		
(1)	Defective heating element	Check for 28-vac between terminal strip and ground.	If voltage exists, replace heating element.

Possible Causes	Isolation Procedure	Correction
B. AFT WASTE WATER DRAIN MAST HEATER INOPERATIVE (Continued)		
(2) Defective wiring	With water waste heater circuit breakers open and mast heater control switch open, check for continuity between engine 3 ground control relay and terminal strip.	If continuity does not exist, repair or replace wiring (see Wire Diagram Manual).

WATER LINES - TROUBLE SHOOTING

1. General

A. The waste water drain masts are located on the bottom exterior of the airplane and in the approximate fuselage areas of the lavatories and galleys.

B. If the waste water drain masts require frequent replacement due to a defective heating element (possible overheating), the waste water mast heater external power control relay should be suspected as being faulty. Test procedures accomplished on various systems during ground maintenance require that flight conditions be simulated by operation of the nose gear ground shift mechanism or opening the ground control relays circuit breakers. The mast heater external power control relay is provided to ensure that with external electrical power supplied to the electrical buses, only 28-vdc is applied to the mast heater elements regardless of ground control relays operation. If the waste water mast heater external power control relay is not energized when flight conditions are simulated, 115-vac is applied to the mast heater elements.

C. 28-vdc or 115-vac to the waste water drain mast heaters is controlled through the ground control relays (see Wiring Diagram Manual).

2. Tools and Equipment Required

A. A multimeter, Simpson Model 260, or equivalent, is required for voltage and continuity checks.

3. Trouble Shooting Water Lines Ice Protection Heaters

Possible Causes	Isolation Procedure	Correction
A. WASTE WATER DRAIN MAST HEATER INOPERATIVE		
(1) Defective heating element	With airplane on ground, external electrical power applied to all buses, and mast heater control switch in on position, check for 28-vdc at heater terminal strip.	If 28-vdc exists, replace waste water mast. If no voltage exists, proceed to (2).

Possible Causes	Isolation Procedure	Correction
A. WASTE WATER DRAIN MAST HEATER INOPERATIVE (Continued)		
(2) Defective wiring or mast heater control switch	Open water waste heaters circuit breaker (28-vdc). Check continuity between applicable ground control relay and heater terminal strip (see Wiring Diagram Manual).	If no continuity, repair wiring or replace switch as required.

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WATER LINES - TROUBLE SHOOTING

1. General (Airplanes Without Service Bulletin 30-27 Incorporated)

   A. The waste water drain masts are located on the bottom exterior of the airplane and in the approximate fuselage areas of the lavatories and galleys.

   B. 28-vdc or 115-vac to the aft waste water drain mast heaters is controlled through a relay in the right ground control relays circuit (see Wiring Diagram Manual). Power to the forward heater is controlled through a relay of the left ground control relays circuit.

1. General (Airplanes With Service Bulletin 30-27 Incorporated)

   A. The waste water drain masts are located on the bottom exterior of the airplane and in the approximate fuselage areas of the lavatories and galleys.

   B. If the waste water drain masts require frequent replacement due to a defective heating element (possible overheating), the waste water mast heater external power control relay should be suspected as being faulty. Test procedures accomplished on various systems during ground maintenance require that flight conditions be simulated by operation of the nose gear ground shift mechanism or opening the ground control relays circuit breakers. The mast heater external power control relay is provided to ensure that with external electrical power supplied to the electrical buses, only 28-vdc is applied to the mast heater elements regardless of ground control relays operation. If the waste water mast heater external power control relay is not energized when flight conditions are simulated; 115-vac is applied to the mast heater elements.

   C. 28-vdc or 115-vac to the aft waste water drain mast heaters is controlled through a relay in the right ground control relays circuit (see Wiring Diagram Manual). Power to the forward heater is controlled through a relay of the left ground control relays circuit.

2. Tools and Equipment Required

   A. A multimeter, Simpson Model 260, or equivalent, is required for voltage and continuity checks.

3. Trouble Shooting Water Lines Ice Protection Heaters

Possible Causes	Isolation Procedure	Correction
A. WASTE WATER DRAIN MAST HEATER INOPERATIVE		
(1) Defective heating element	With airplane on ground, external electrical power applied to all buses, and mast heater control switch in on position, check for 28-vdc at heater terminal strip.	If 28-vdc exists, replace waste water mast. If no voltage exists, proceed to (2).
(2) Defective wiring or mast heater control switch	Open water waste heaters circuit breaker (28-vdc). Check continuity between applicable ground control relay and heater terminal strip (see Wiring Diagram Manual).	If no continuity repair wiring or replace switch as required.
B. POTABLE WATER SYSTEM SERVICE PANEL HEATER INOPERATIVE BELOW AMBIENT TEMPERATURE OF 65 (±10)°F (18.3 (±5.6)°C)		
(1) Defective heating element	Check for 115-vac at heater terminal.	If voltage exists, replace heater
(2) Defective wiring	Open water service panel heater circuit breaker. Check continuity of wiring between circuit breaker and heater terminal and between heater and ground (see Wiring Diagram Manual).	Repair or replace wiring as required.
C. POTABLE WATER SYSTEM DRAIN FITTING HEATER INOPERATIVE.		
(1) Defective heating element	Check for 115-vac at water system service panel heater terminal.	If voltage exists, proceed to next procedure. If no voltage proceed to (2).

C. POTABLE WATER SYSTEM DARIN FITTING HEATER INOPERATIVE (Continued)

(1)	(Continued)	Disconnect drain line fitting heater. Check continuity through heater.	If no continuity, replace heater
(2)	Defective wiring	Open water service panel heater circuit breaker. Check continuity of wiring connected to service panel heater terminals (see Wiring Diagram Manual).	Repair or replace wiring as required.

WATER LINES - TROUBLE SHOOTING

1. General

A. The waste water drain masts are located on the bottom exterior of the airplane and in the approximate fuselage areas of the lavatories and galleys.

B. If the waste water drain masts require frequent replacement due to a defective heating element (possible overheating), the waste water mast heater external power control relay (airplanes N8092U - N8099U, N8966U through N8975U) should be suspected as being faulty. Test procedures accomplished on various systems during ground maintenance require that flight conditions be simulated by operation of the nose gear ground shift mechanism or opening the ground control relays circuit breakers. The mast heater external power control relay is provided to ensure that with external electrical power supplied to the electrical buses, only 28-vdc is applied to the mast heater elements regardless of ground control relays operation. If the waste water mast heater external power control relay is not energized when flight conditions are simulated; 115-vac is applied to the mast heater elements.

C. 28-vdc or 115-vac to the aft waste water drain mast heaters is controlled through a relay in the right ground control relays circuit (see Wiring Diagram Manual). Power to the forward heater is controlled through a relay of the left ground control relays circuit.

D. 115-vac to the potable water system drain panel heater is controlled through a circuit breaker located on the aft cabin electrical panel.

E. 115-vac to the forward water waste panel heaters is controlled through a circuit breaker located on the forward cabin electrical panel. Power to the aft water waste panel heaters is through a circuit breaker located on the aft cabin electrical panel.

2. Tools and Equipment Required

A. A multimeter, Simpson Mode_ _60, or equivalent, is required for voltage and continuity checks.

3. Trouble Shooting Water Lines Ice Protection Heaters

Possible Causes	Isolation Procedure	Correction
A. WASTE WATER DRAIN MAST HEATER INOPERATIVE		
(1) Defective heating element	With airplane on ground, external electrical power	If 28-vdc exists, replace waste water mast.

Possible Causes	Isolation Procedure	Correction
A. WASTE WATER DRAIN MAST HEATER INOPERATIVE (Continued)		
	applied to all buses, and mast heater control switch in on position, check for 28-vdc at heater terminal strip.	If no voltage exists, proceed to (2).
(2) Defective wiring or mast heater control switch	Open water waste heaters circuit breaker (28-vdc). Check continuity between applicable ground control relay and heater terminal strip (see Wiring Diagram Manual).	If no continuity, repair wiring or replace switch as required.
B. POTABLE WATER SYSTEM DRAIN PANEL HEATER INOPERATIVE BELOW AMBIENT TEMPERATURE OF 65 (±10)°F (18.3 (±5.6)°C).		
(1) Defective heating element	Check for 115-vac at heater terminal.	If voltage exists, replace heater.
(2) Defective wiring	Open water service panel heater circuit breaker. Check continuity of wiring between circuit breaker and heater terminal and between heater and ground (see Wiring Diagram Manual).	Repair or replace wiring as required.
C. WASTE WATER SERVICE PANEL HEATER INOPERATIVE (AIRPLANES N8966U THROUGH N8975U)		
(1) Defective heating element	Check for 115-vac at waste water service panel heater terminal strip.	If voltage exists, proceed to next procedure. If no voltage proceed to (2).
	Disconnect heater electrical wiring. Check continuity through heater.	If no continuity, replace heater.

Possible Causes	Isolation Procedure	Correction
C. WASTE WATER SERVICE PANEL HEATER INOPERATIVE (AIRPLANES N8966U THROUGH N8975U). (Continued)		
(2) Defective wiring	Open applicable waste water service panel heaters circuit breaker. Check continuity of wiring connected between circuit breaker and terminal strip (see Wiring Diagram Manual).	Repair or replace wiring as required.

WATER LINES - TROUBLE SHOOTING

1. General

A. The waste water drain masts are located on the bottom exterior of the airplane and in the approximate fuselage areas of the lavatories and galleys.

B. If the waste water drain masts require frequent replacement due to a defective heating element (possible overheating), the waste water mast heater external power control relay (airplanes 65 through 69, 72 through 74, 77, and 78) should be suspected as being faulty. Test procedures accomplished on various systems during ground maintenance require that flight conditions be simulated by operation of the nose gear ground shift mechanism or opening the ground control relays circuit breakers. The mast heater external power control relay is provided to ensure that with external electrical power supplied to the electrical buses, only 28-vdc is applied to the mast heater elements regardless of ground control relays operation. If the waste water mast heater external power control relay is not energized when flight conditions are simulated, 115-vac is applied to the mast heater elements.

C. 28-vdc or 115-vac to the waste water drain mast heaters is controlled through the ground control relays (see Wiring Diagram Manual).

D. 115-vac to the potable water system drain panel heater (airplanes 70 through 74) is controlled through a circuit breaker located on the aft cabin electrical panel.

2. Tools and Equipment Required

A. A multimeter, Simpson Model 260, or equivalent, is required for voltage and continuity checks.

3. Trouble Shooting Water Lines Ice Protection Heaters

Possible Causes	Isolation Procedure	Correction
A. WASTE WATER DRAIN MAST HEATER INOPERATIVE.		
(1) Defective heating element	With airplane on ground, external electrical power applied to all buses, and mast heater control switch in on position; check for 28-vdc at heater terminal strip.	If 28-vdc exists, replace waste water mast. If no voltage exists, proceed to (2).

Possible Causes	Isolation Procedure	Correction
A. WASTE WATER DRAIN MAST HEATER INOPERATIVE. (Continued)		
(2) Defective wiring or mast heater control switch	Open water waste heaters circuit breaker (28-vdc). Check continuity between applicable ground control relay and heater terminal strip (see Wiring Diagram Manual).	If no continuity, repair wiring or replace switch as required.
B. POTABLE WATER SYSTEM SERVICE PANEL HEATER INOPERATIVE BELOW AMBIENT TEMPERATURE OF 65 (±10)°F (18.3 (±5.6)°C) (AIRPLANES 70 THROUGH 74).		
(1) Defective heating element	Check for 115-vac at heater terminal.	If voltage exists, replace heater
(2) Defective wiring	Open water service panel heater circuit breaker. Check continuity of wiring between circuit breaker and heater terminal and between heater and ground (see Wiring Diagram Manual).	Repair or replace wiring as required.
C. POTABLE WATER SYSTEM DRAIN FITTING HEATER INOPERATIVE (AIRPLANES 70 THROUGH 74).		
(1) Defective heating element	Check for 115-vac at water system service panel heater terminal.	If voltage exists, proceed to next procedure. If no voltage proceed to (2).
	Disconnect drain line fitting heater. Check continuity through heater.	If no continuity, replace heater.
(2) Defective wiring	Open water service panel heater circuit breaker. Check continuity of wiring connected to service panel heater terminals (see Wiring Diagram Manual).	Repair or replace wiring as required.

WATER LINES - TROUBLE SHOOTING

1. General

A. The waste water drain masts are located on the bottom exterior of the airplane and in the approximate fuselage areas of the lavatories and galleys.

B. If the waste water drain masts require frequent replacement due to a defective heating element (possible overheating), the waste water mast heater external power control relay should be suspected as being faulty. Test procedures accomplished on various systems during ground maintenance require that flight conditions be simulated by operation of the nose gear ground shift mechanism or opening the ground control relays circuit breakers. The mast heater external power control relay is provided to ensure that with external electrical power supplied to the electrical buses, only 28-vdc is applied to the mast heater elements regardless of ground control relays operation. If the waste water mast heater external power control relay is not energized when flight conditions are simulated, 115-vac is applied to the mast heater elements.

C. 28-vdc or 115-vac to the waste water drain mast heaters is controlled through the ground control relays (see Wiring Diagram Manual).

D. 115-vac to the potable water system drain panel heater is controlled through a circuit breaker located on the aft cabin electrical panel.

2. Tools and Equipment Required

A. A multimeter, Simpson Model 260, or equivalent, is required for voltage and continuity checks.

3. Trouble Shooting Water Lines Ice Protection Heaters

Possible Causes	Isolation Procedure	Correction
A. WASTE WATER DRAIN MAST HEATER INOPERATIVE		
(1) Defective heating element	With airplane on ground, external electrical power applied to all buses, and mast heater control switch in on position; check for 28-vdc at heater terminal strip.	If 28-vdc exists, replace waste water mast. If o voltage exists, proceed to (2).

Possible Causes	Isolation Procedure	Correction
A. WASTE WATER DRAIN MAST HEATER INOPERATIVE. (Continued)		
(2) Defective wiring or mast heater control switch	Open water waste heaters circuit breaker (28-vdc). Check continuity between applicable ground control relay and heater terminal strip (see Wiring Diagram Manual).	If no continuity, repair wiring or replace switch as required.
B. POTABLE WATER SYSTEM SERVICE PANEL HEATER INOPERATIVE BELOW AMBIENT TEMPERATURE OF 65 (±10)°F (18.3 (±5.6)°C).		
(1) Defective heating element	Check for 115-vac at heater terminal.	If voltage exists, replace heater.
(2) Defective wiring	Open water service panel heater circuit breaker. Check continuity of wiring between circuit breaker and heater terminal and between heater and ground (see Wiring Diagram Manual).	Repair or replace wiring as required.
C. POTABLE WATER SYSTEM DRAIN FITTING HEATER INOPERATIVE.		
(1) Defective heating element	Check for 115-vac at water system service panel heater terminal.	If voltage exists, proceed to next procedure. If no voltage proceed to (2).
	Disconnect drain line fitting heater. Check continuity through heater.	If no continuity, replace heater.
(2) Defective wiring	Open water service panel heater circuit breaker. Check continuity of wiring connected to service panel heater terminals (see Wiring Diagram Manual).	Repair or replace wiring as required.

WASTE WATER DRAIN MAST HEATERS - MAINTENANCE PRACTICES

1. General

A. Removal/Installation of the waste water drain mast heaters necessitates removal of the drain masts. Each drain mast is constructed in two halves which separate to remove the tubular heating element. The three drain masts are located on the bottom of the fuselage, one on the center line between the wing and forward passenger entrance door, and two located just forward of the tail skid on the left and right side of the airplane centerline.

B. Access to piping and heater electrical connections for the forward drain mast heater is through the forward lower cargo compartment. Access to the aft drain mast heaters is through the aft accessory compartment. Access to the drain masts attachments is from the outside of the airplane.

C. Maintenance practices for all drain mast heaters are identical.

2. Tools and Equipment Required

A. RTB 1016 Silicone Sealant or equivalent is used to seal area between fairing and heater.

3. Removal/Installation Waste Water Drain Mast Heater

A. Remove Heater

(1) Open water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

(2) Disconnect heater electrical connections.

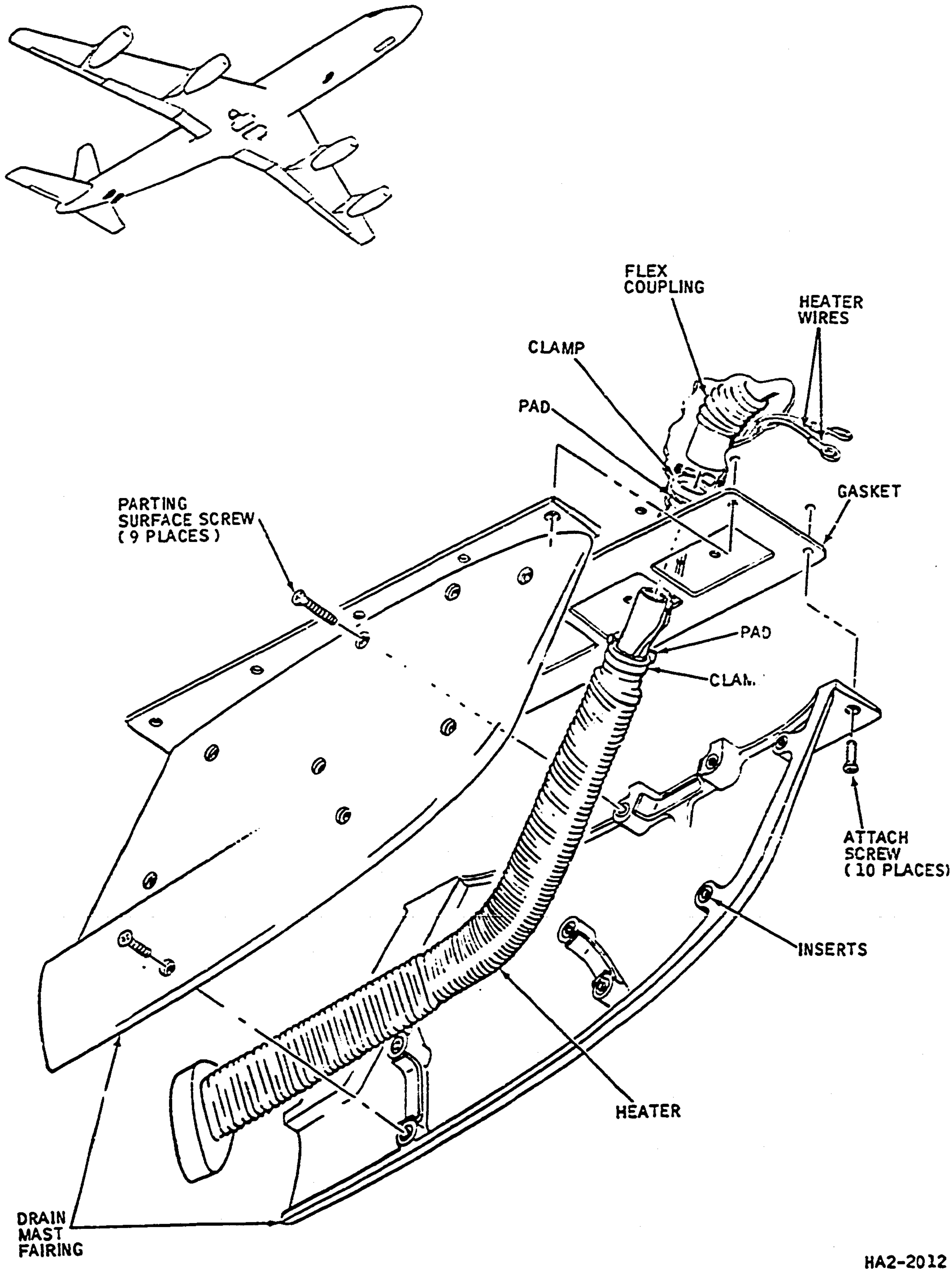
(3) Loosen clamps on drain line flex coupling just above drain mast.

(4) Loosen flex coupling and disconnect from end of drain mast heating element while sliding coupling up drain line.

(5) From outside of airplane, remove drain mast attaching screws and remove mast with heating element installed.

(6) Remove drain mast parting surface screws and separate drain mast halves.

(7) Remove heating element from drain mast.



Waste Water Drain Mast Heaters -- Installation
Figure 201

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B. Install Heater

(1) Make certain water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel, are open.

(2) Place heating element on half of drain mast.

(3) Position other half of drain mast in place and install parting surface screws.

(4) Position drain mast on fuselage and install attaching screws.

(5) Apply sealant from fairing to heater above cushion.

NOTE: Height of sealant should not exceed upper surface of fairing.

(6) From inside airplane, slide flexible coupling down on drain line and onto upper end of heating element.

(7) Install clamps on upper and lower ends of flexible couplings.

(8) Connect electrical connections.

(9) Close water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

4. Adjustment/Test Waste Water Drain Mast Heaters

A. Test Heater

(1) Open water waste heaters 28-vdc circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel.

(2) Place mast heater control switch in on position.

(3) Feel inside open end of drain mast heaters; no increase of temperature should be felt while airplane is on ground.

(4) Open water waste heaters 115-vac circuit breaker and close water waste heaters 28-vdc circuit breaker on heat, vent, and ice protection section of EPC circuit breaker panel.

(5) Feel inside open end of drain mast heater, note that temperature increase is felt as heater warms up to ground heat (low range) temperature.

(6) Place mast heater control switch in off position.

(7) Close water waste heaters 115-volt, ac circuit breaker.

WASTE WATER DRAIN MAST HEATERS - MAINTENANCE PRACTICES

1. General

A. Removal/Installation of the waste water drain mast heaters necessitates removal of the drain masts. Each drain mast is constructed in two halves which separate to remove the tubular heating element. The three drain masts are located on the bottom of the fuselage, one on the center line between the wing and forward passenger entrance door, and two located just forward of the aft accessory compartment door on the left and right side of the airplane centerline.

B. Access to piping and heater electrical connections for the forward drain mast heater is through the forward lower cargo compartment. Access to the aft drain mast heaters is through the aft accessory compartment. Access to the drain masts attachments is from the outside of the airplane.

C. Maintenance practices for all drain mast heaters are identical.

2. Tools and Equipment Required

A. RTB 1016 Silicone Sealant or equivalent is used to seal area between fairing and heater.

3. Removal/Installation Waste Water Drain Mast Heater

A. Remove Heater

(1) Open water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

(2) Disconnect heater electrical connections.

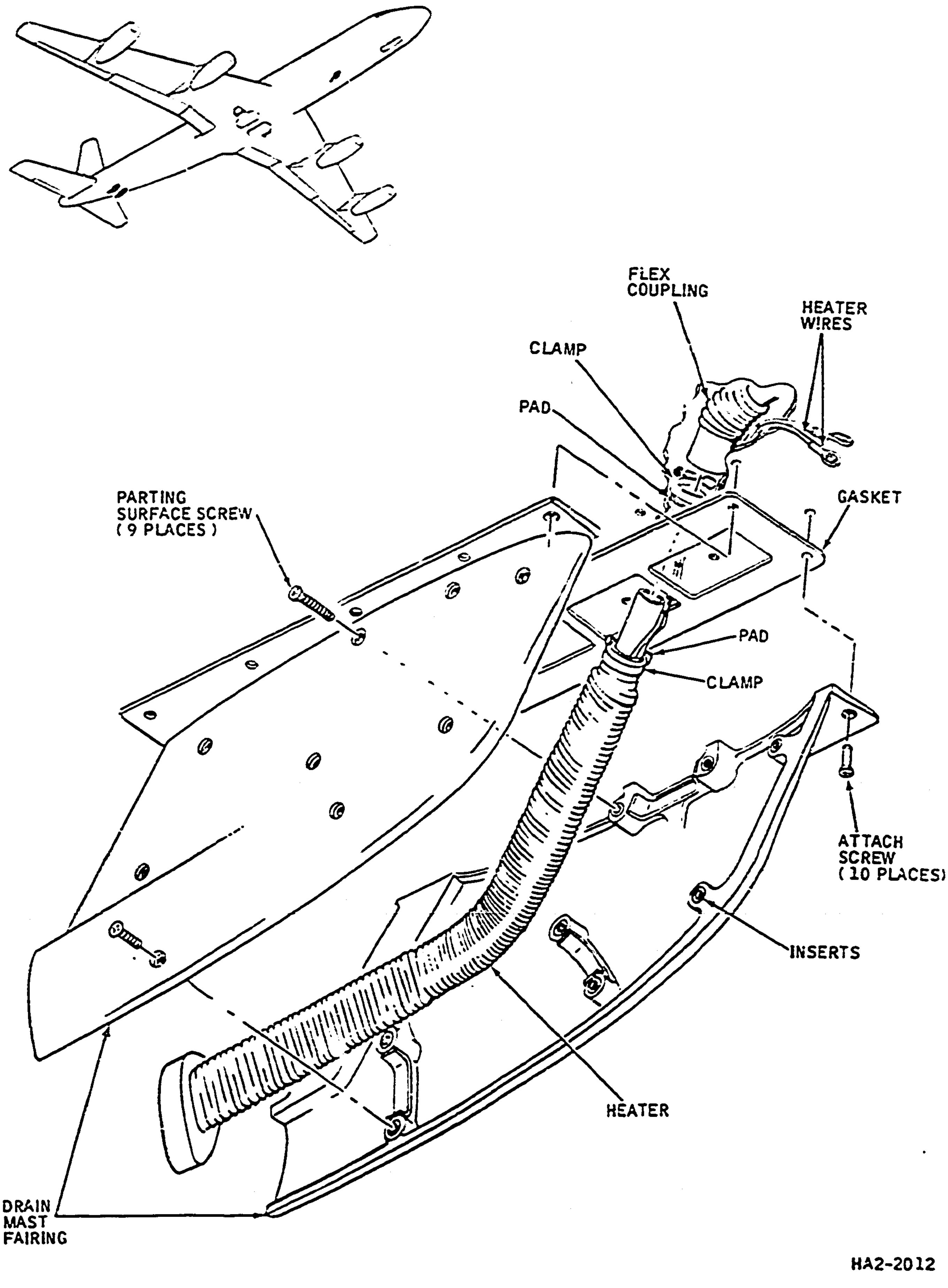
(3) Loosen clamps on drain line flex coupling just above drain mast.

(4) Loosen flex coupling and disconnect from end of drain mast heating element while sliding coupling up drain line.

(5) From outside of airplane, remove drain mast attaching screws and remove mast with heating element installed.

(6) Remove drain mast parting surface screws and separate drain mast halves.

(7) Remove heating element from drain mast.



Waste Water Drain Mast Heaters -- Installation
Figure 201

B. Install Heater

(1) Make certain water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel are open.

(2) Place heating element on half of drain mast.

(3) Position other half of drain mast in place and install parting surface screws.

(4) Position drain mast on fuselage and install attaching screws.

(5) Apply sealant from fairing to heater above cushion.

<u>NOTE</u>: Height of sealant should not exceed upper surface of fairing.

(6) From inside airplane, slide flexible coupling down on drain line and onto upper end of heating element.

(7) Install clamps on upper and lower ends of flexible couplings.

(8) Connect electrical connections.

(9) Close water waste heater circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

4. <u>Adjustment/Test Waste Water Drain Mast Heaters</u>

A. Test Heater

(1) Open water waste heaters 28-vdc circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel.

(2) Place mast heater control switch in on position.

(3) Feel inside open end of drain mast heaters; no increase of temperature should be felt while airplane is on ground.

(4) Open water waste heaters 115-vac circuit breaker and close water waste heaters 28-vdc circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel.

(5) Feel inside open end of drain mast heater; note that temperature increase is felt as heater warms up to ground heat (low range) temperature.

(6) Place mast heater control switch in off position.

(7) Close water waste heaters 115-vac circuit breaker.

WASTE WATER DRAIN MAST HEATERS - MAINTENANCE PRACTICES

1. General

A. Removal/Installation of the waste water drain mast heaters necessitates removal of the drain masts. Each drain mast is constructed in two halves which separate to remove the tubular heating element. The four drain masts are located on the bottom of the fuselage, two near the center line between the wing and forward passenger entrance door, and two located just forward of the tail skid on the left and right side of the airplane centerline.

B. Access to piping and heater electrical connections for the forward drain mast heaters is through the forward lower cargo compartment. Access to the aft drain mast heaters is through the aft accessory compartment. Access to the drain masts attachments is from the outside of the airplane.

C. Maintenance practices for all drain mast heaters are identical.

2. Tools and Equipment Required

A. RTB 1016 Silicone Sealant or equivalent is used to seal area between fairing and heater.

3. Removal/Installation Waste Water Drain Mast Heater

A. Remove Heater

(1) Open water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

(2) Disconnect heater electrical connections.

(3) Loosen clamps on drain line flex coupling just above drain mast.

(4) Loosen flex coupling and disconnect from end of drain mast heating element while sliding coupling up drain line.

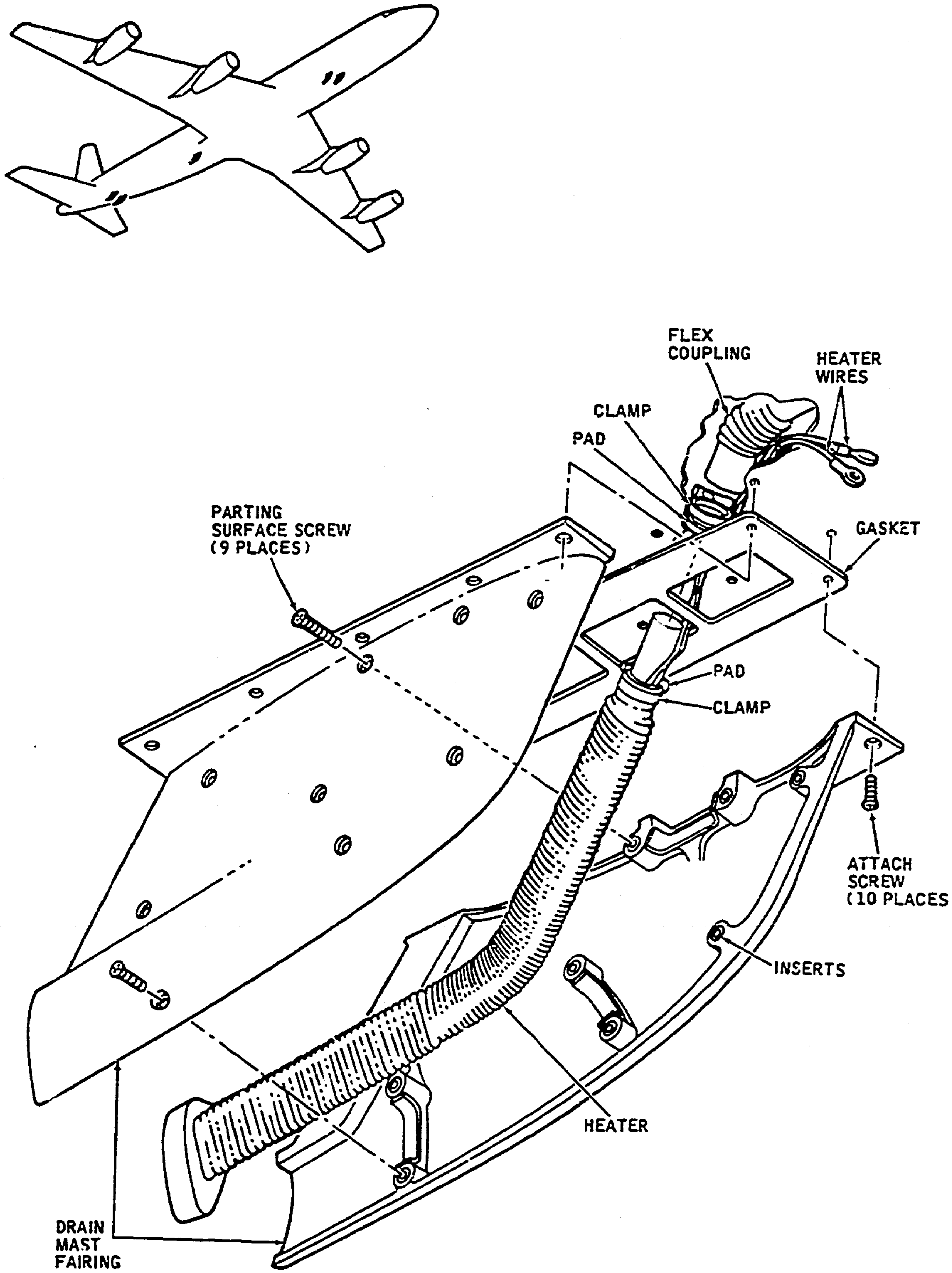
(5) From outside of airplane, remove drain mast attaching screws and remove mast with heating element installed.

(6) Remove drain mast parting surface screws and separate drain mast halves.

(7) Remove heating element from drain mast.

B. Install Heater

(1) Make certain water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel, are open.



Waste Water Drain Mast Heaters -- Installation
Figure 201

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(2) Place heating element on half of drain mast.

(3) Position other half of drain mast in place and install parting surface screws.

(4) Position drain mast on fuselage and install attaching screws.

(5) Apply sealant from fairing to heater above cushion.

NOTE: Height of sealant should not exceed upper surface of fairing.

(6) From inside airplane, slide flexible coupling down on drain line and onto upper end of heating element.

(7) Install clamps on upper and lower ends of flexible couplings.

(8) Connect electrical connections.

(9) Close water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

4. Adjustment/Test Waste Water Drain Mast Heaters

A. Test Heater

(1) Open water waste heaters 28-vdc circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel.

(2) Place mast heater control switch in on position.

(3) Feel inside open end of drain mast heaters; no increase of temperature should be felt while airplane is on ground.

(4) Open water waste heaters 115-vac circuit breaker and close water waste heaters 28-vdc circuit breaker on heat, vent, and ice protection section of EPC circuit breaker panel.

(5) Feel inside open end of drain mast heater, note that temperature increase is felt as heater warms up to ground heat (low range) temperature.

(6) Place mast heater control switch in off position.

(7) Close water waste heaters 115-volt, ac circuit breaker.

WASTE WATER DRAIN MAST HEATERS - MAINTENANCE PRACTICES

1. General

A. Removal/installation of the waste water drain mast heaters necessitates removal of the drain masts. Each drain mast is constructed in two halves which separate to remove the tubular heating element. The five drain masts are located on the bottom of the fuselage, two near the centerline between the wing and forward passenger entrance door, one just aft of the wing on the left side of the centerline, and two located just forward of the tail skid on the left and right side of the airplane centerline.

B. Access to piping and heater electrical connections for the forward drain mast heaters is through the forward lower cargo compartment. Access to the center drain mast heater is through the aft lower cargo compartment. Access to the aft drain mast heaters is through the aft accessory compartment. Access to the drain masts attachments is from the outside of the airplane.

C. Maintenance practices for all drain mast heaters are identical.

2. Tools and Equipment Required

A. RTB 1016 Silicone Sealant or equivalent is used to seal area between fairing and heater.

3. Removal/Installation Waste Water Drain Mast Heater

A. Remove Heater

(1) Open water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

(2) Disconnect heater electrical connections.

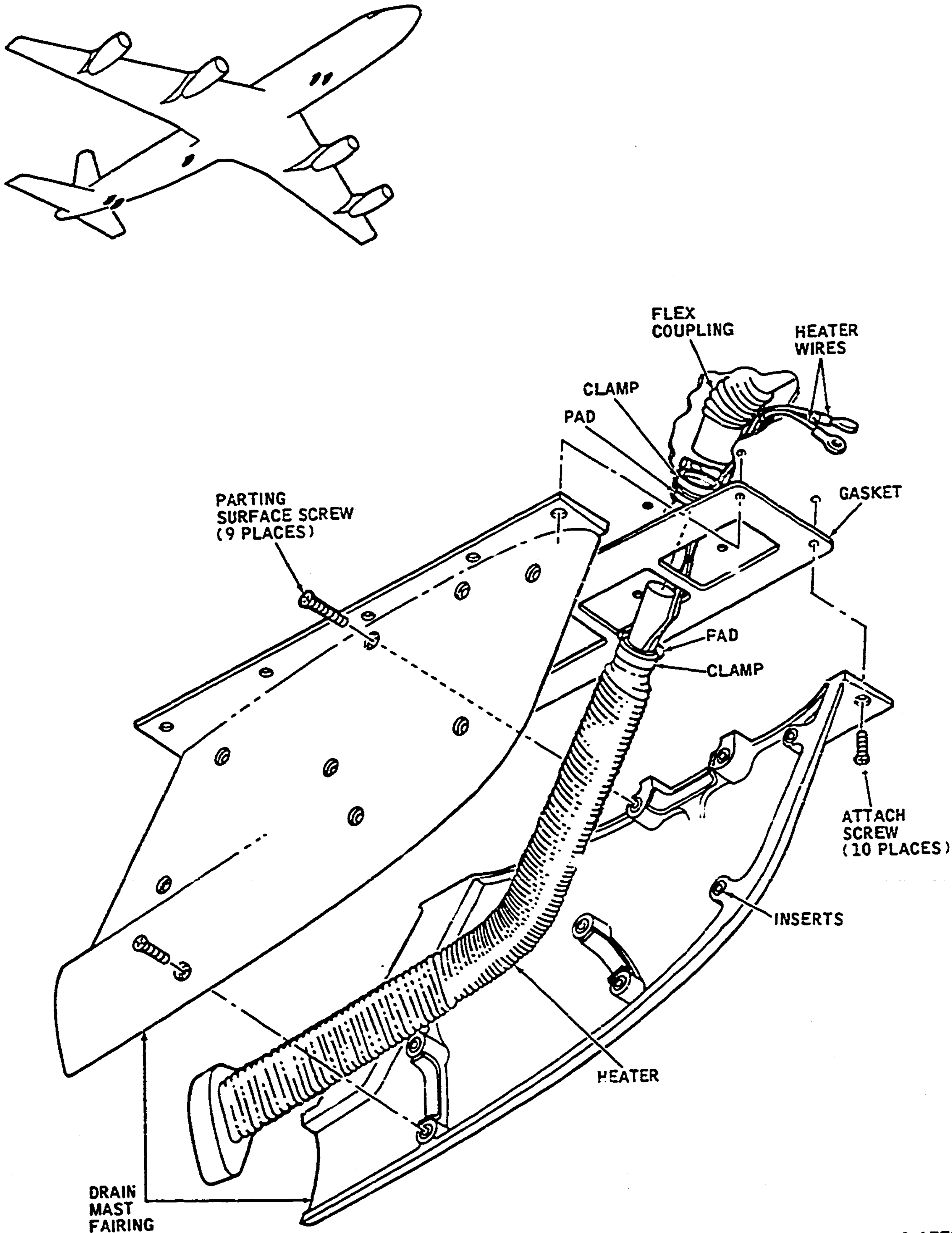
(3) Loosen clamps on drain line flex coupling just above drain mast.

(4) Loosen flex coupling and disconnect from end of drain mast heating element while sliding coupling up drain line.

(5) From outside of airplane, remove drain mast attaching screws and remove mast with heating element installed.

(6) Remove drain mast parting surface screws and separate drain mast halves.

(7) Remove heating element from drain mast.



Waste Water Drain Mast Heaters -- Installation
Figure 201

B. Install Heater

(1) Make certain water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel, are open.

(2) Place heating element on half of drain mast.

(3) Position other half of drain mast in place and install parting surface screws.

(4) Position drain mast on fuselage and install attaching screws.

(5) Apply sealant from fairing to heater above cushion.

NOTE: Height of sealant should not exceed upper surface of fairing.

(6) From inside airplane, slide flexible coupling down on drain line and onto upper end of heating element.

(7) Install clamps on upper and lower ends of flexible couplings.

(8) Connect electrical connections.

(9) Close water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

4. Adjustment/Test Waste Water Drain Mast Heaters

A. Test Heater

(1) Open water waste heaters 28-vdc circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel.

(2) Place mast heater control switch in on position.

(3) Feel inside open end of drain mast heaters; no increase of temperature should be felt while airplane is on ground.

(4) Open water waste heaters 115-vac circuit breaker and close water waste heaters 28-vdc circuit breaker on heat, vent, and ice protection section of EPC circuit breaker panel.

(5) Feel inside open end of drain mast heater, note that temperature increase is felt as heater warms up to ground heat (low range) temperature.

(6) Place mast heater control switch in off position.

(7) Close water waste heaters 115-volt, ac circuit breaker.

WASTE WATER DRAIN MAST HEATERS - MAINTENANCE PRACTICES

1. General

A. Removal/installation of the waste water drain mast heaters necessitates removal of the drain masts. Each drain mast is constructed in two halves which separate to remove the tubular heating element. The four drain masts are located on the bottom of the fuselage, two near the centerline between the wing and forward passenger entrance door, and two located just forward of the aft accessory compartment door on the left and right side of the airplane centerline.

B. Access to piping and heater electrical connections for the forward drain mast heaters is through the forward lower cargo compartment. Access to the aft drain mast heaters is through the aft accessory compartment. Access to the drain masts attachments is from the outside of the airplane.

C. Maintenance practices for all drain mast heaters are identical.

2. Tools and Equipment Required

A. RTB 1016 Silicone Sealant or equivalent is used to seal area between fairing and heater.

3. Removal/Installation Waste Water Drain Mast Heater

A. Remove Heater

(1) Open water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

(2) Disconnect heater electrical connections.

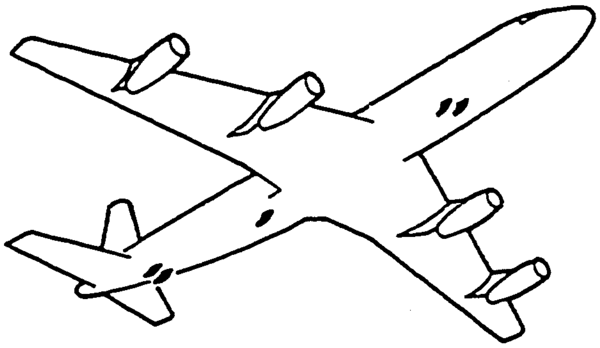
(3) Loosen clamps on drain line flex coupling just above drain mast.

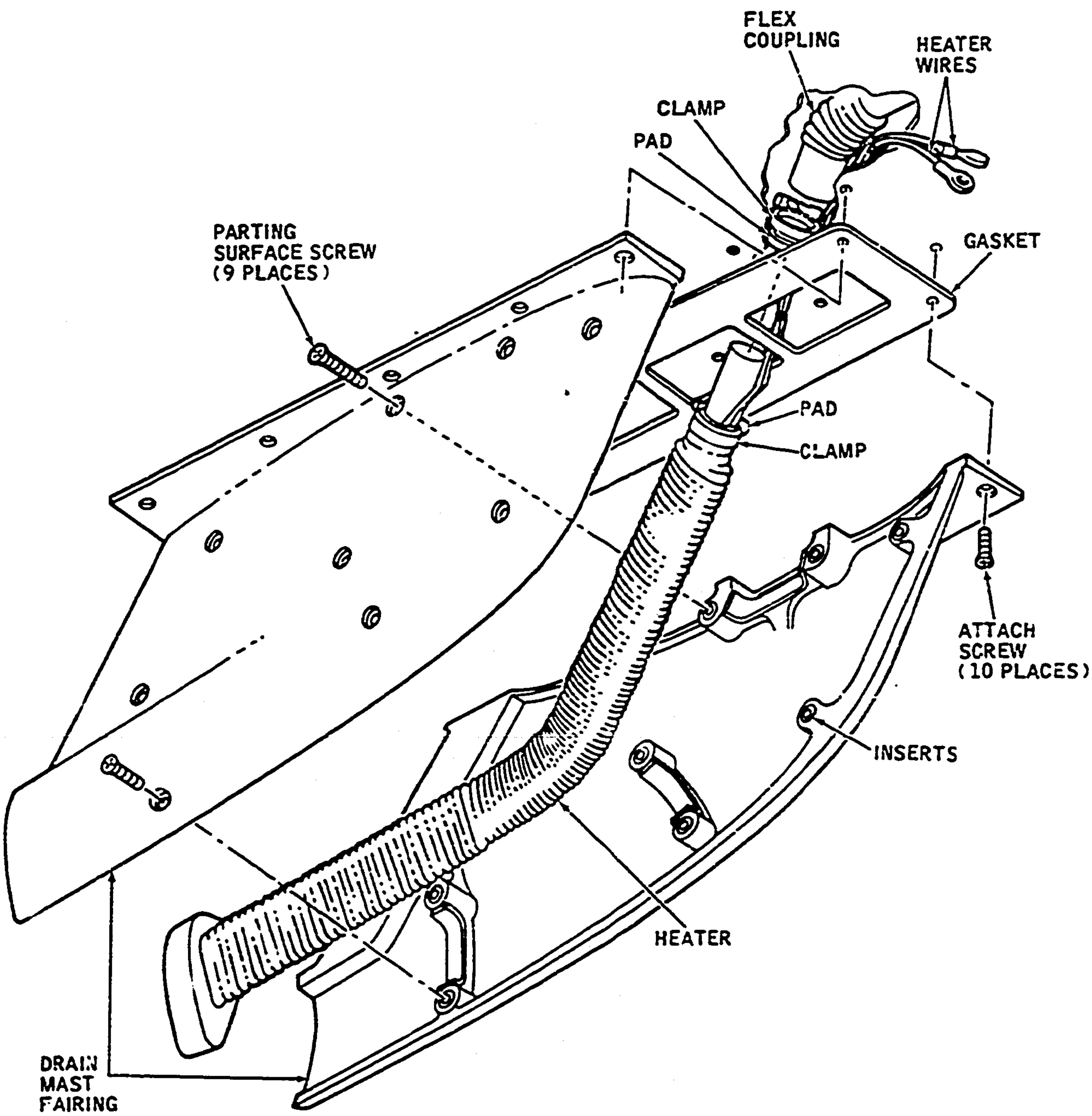
(4) Loosen flex coupling and disconnect from end of drain mast heating element while sliding coupling up drain line.

(5) From outside of airplane, remove drain mast attaching screws and remove mast with heating element installed.

(6) Remove drain mast parting surface screws and separate drain mast halves.

(7) Remove heating element from drain mast.





Waste Water Drain Mast Heaters -- Installation
Figure 201

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B. Install Heater

(1) Make certain water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel are open.

(2) Place heating element on half of drain mast.

(3) Position other half of drain mast in place and install parting surface screws.

(4) Position drain mast on fuselage and install attaching screws.

(5) Apply sealant from fairing to heater above cushion.

NOTE: Height of sealant should not exceed upper surface of fairing.

(6) From inside airplane, slide flexible coupling down on drain line and onto upper end of heating element.

(7) Install clamps on upper and lower ends of flexible couplings.

(8) Connect electrical connections.

(9) Close water waste heater circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

4. Adjustment/Test Waste Water Drain Mast Heaters

A. Test Heater

(1) Open water waste heaters 28-vdc circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel.

(2) Place mast heater control switch in on position.

(3) Feel inside open end of drain mast heaters; no increase of temperature should be felt while airplane is on ground.

(4) Open water waste heaters 115-vac circuit breaker and close water waste heaters 28-vdc circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel.

(5) Feel inside open end of drain mast heater; note that temperature increase is felt as heater warms up to ground heat (low range) temperature.

(6) Place mast heater control switch in off position.

(7) Close water waste heaters 115-vac circuit breaker.

WASTE WATER DRAIN MAST HEATERS - MAINTENANCE PRACTICES

1. General

A. Removal/installation of the waste water drain mast heaters necessitates removal of the drain masts. Each drain mast is constructed in two halves which separate to remove the tubular heating element. The two drain masts are located on the bottom of the fuselage near the centerline between the wing and forward passenger entrance door.

B. Access to piping and heater electrical connections for the forward drain mast heaters is through the forward lower cargo compartment. Access to the aft drain mast heaters is through the aft accessory compartment. Access to the drain masts attachments is from the outside of the airplane.

C. Maintenance practices for both drain mast heaters are identical.

2. Tools and Equipment Required

A. RTB 1016 Silicone Sealant or equivalent is used to seal area between fairing and heater.

3. Removal/Installation Waste Water Drain Mast Heater

A. Remove Heater

(1) Open water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

(2) Disconnect heater electrical connections.

(3) Loosen clamps on drain line flex coupling just above drain mast.

(4) Loosen flex coupling and disconnect from end of drain mast heating element while sliding coupling up drain line.

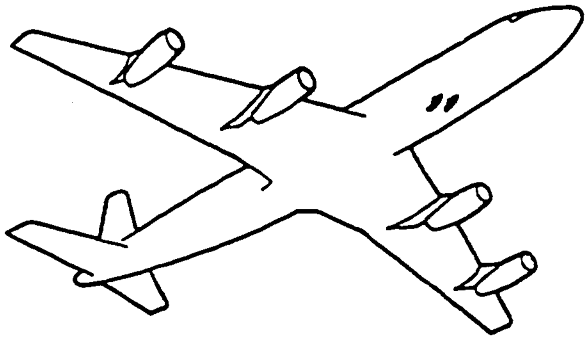
(5) From outside of airplane, remove drain mast attaching screws and remove mast with heating element installed.

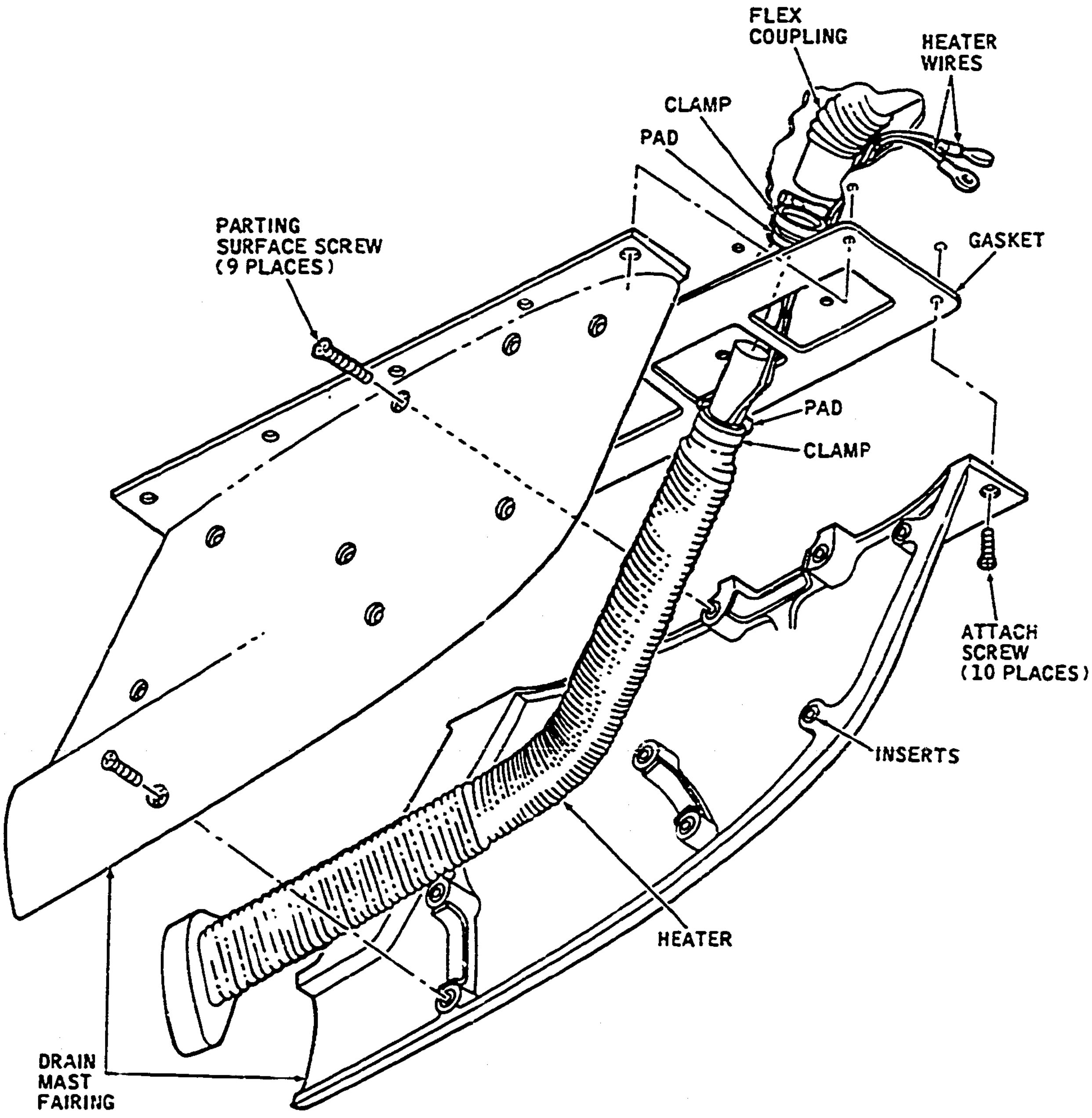
(6) Remove drain mast parting surface screws and separate drain mast halves.

(7) Remove heating element from drain mast.

B. Install Heater

(1) Make certain water waste heaters circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel are open.





Waste Water Drain Mast Heaters -- Installation
Figure 201

(2) Place heating element on half of drain mast.

(3) Position other half of drain mast in place and install parting surface screws.

(4) Position drain mast on fuselage and install attaching screws.

(5) Apply sealant from fairing to heater above cushion.

NOTE: Height of sealant should not exceed upper surface of fairing.

(6) From inside airplane, slide flexible coupling down on drain line and onto upper end of heating element.

(7) Install clamps on upper and lower ends of flexible couplings.

(8) Connect electrical connections.

(9) Close water waste heater circuit breakers located on heat, vent, and ice protection (ac and dc bus) section of EPC circuit breaker panel.

4. Adjustment/Test Waste Water Drain Mast Heaters

A. Test Heater

(1) Open water waste heaters 28-vdc circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel.

(2) Place mast heater control switch in on position.

(3) Feel inside open end of drain mast heaters; no increase of temperature should be felt while airplane is on ground.

(4) Open water waste heaters 115-vac circuit breaker and close water waste heaters 28-vdc circuit breaker located on heat, vent, and ice protection section of EPC circuit breaker panel.

(5) Feel inside open end of drain mast heater; note that temperature increase is felt as heater warms up to ground heat (low range) temperature.

(6) Place mast heater control switch in off position.

(7) Close water waste heaters 115-vac circuit breaker.

POTABLE WATER SYSTEM SERVICE PANEL HEATER - MAINTENANCE PRACTICES

1. General

A. The water service panel heater is located on the lower right side of the fuselage just forward of the aft service entrance door. Access to the panel components is from outside the airplane.

2. Tools and Equipment Required

A. Dry ice is used to lower temperature in service panel area.

3. Removal/Installation Water Service Panel Heater

A. Remove Heater

(1) Open water service panel heater circuit breaker located on cabin bus 4 of aft cabin electrical panel.

(2) At service panel, remove fill and overflow nipple caps, mounting nuts, and cap retaining plate.

(3) Lift element away from panel until wire terminals are exposed.

(4) Disconnect wires at terminals and remove element.

(5) Remove rubber abrasion ring around edge of element; retain ring for use on replacement element.

B. Install Heater

(1) Make certain water service panel heater circuit breaker located on cabin bus 4 of aft cabin electrical panel is open.

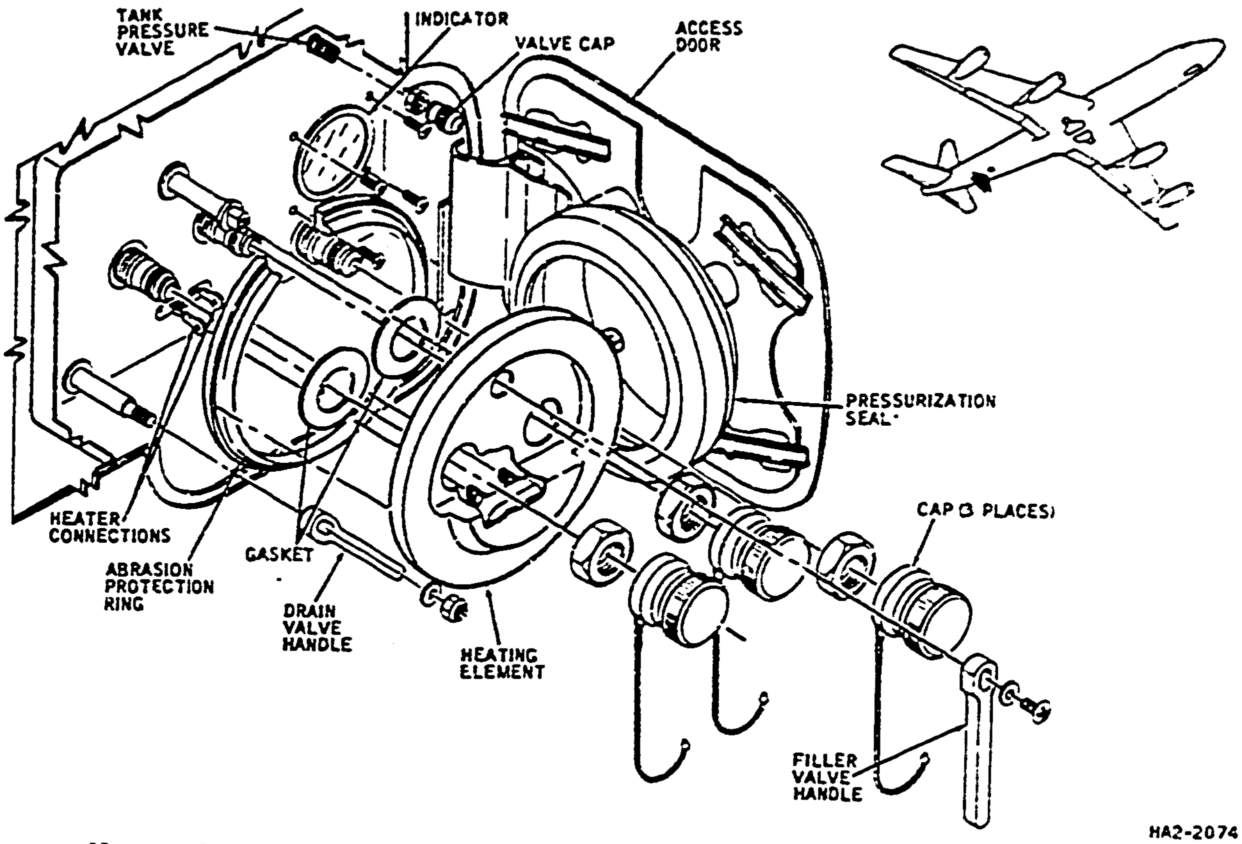
(2) Install rubber abraision ring around edge of element.

(3) Connect wires to element terminals.

(4) Hold element in place, and install cap retaining plate, fill and overflow nipple mounting nuts.

(5) Install caps on nipples.

(6) Close water service panel heater circuit breaker.



Water Service Panel Heating Element -- Installation
Figure 201

4. Adjustment/Test Fresh Water Service Panel Heating Element

A. Test Heating Element

(1) Open water service panel heater circuit breaker located on cabin bus 4 of aft cabin electrical panel.

(2) Using dry ice reduce temperature in area of service panel heating element below 18.3 (±5.6) °C (65 (±10) °F).

(3) Close water service panel heater circuit breaker.

(4) Feel heating element and note increase in temperature.

POTABLE WATER SYSTEM DRAIN PANEL HEATER - MAINTENANCE PRACTICES

1. General

A. The potable water system drain panel heater is located on the lower right side of the fuselage just forward of the aft service entrance door. Access to the panel components is from outside the airplane.

2. Tools and Equipment Required

A. Dry ice is used to lower temperature in service panel area.

3. Removal/Installation Potable Water System Drain Panel Heater

A. Remove Heater

(1) Open water service panel heater circuit breaker located on aft cabin electrical panel.

(2) At drain panel, remove outlet nipple cap, plug, mounting nuts, and cap retaining plate.

(3) Lift element away from panel until wire terminals are exposed.

(4) Disconnect wires at terminals and remove element.

(5) Remove rubber abrasion ring around edge of element; retain ring for use on replacement element.

B. Install Heater

(1) Make certain water service panel heater circuit breaker located on aft cabin electrical panel is open.

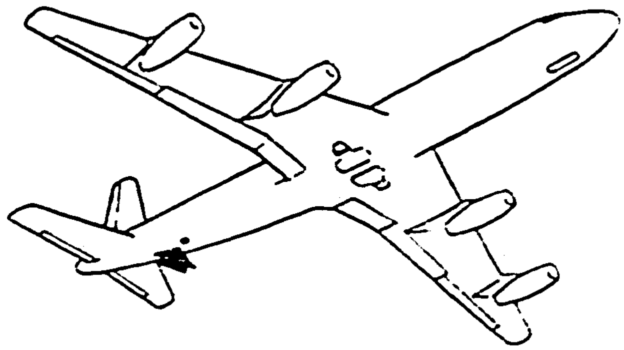
(2) Install rubber abrasion ring around edge of element.

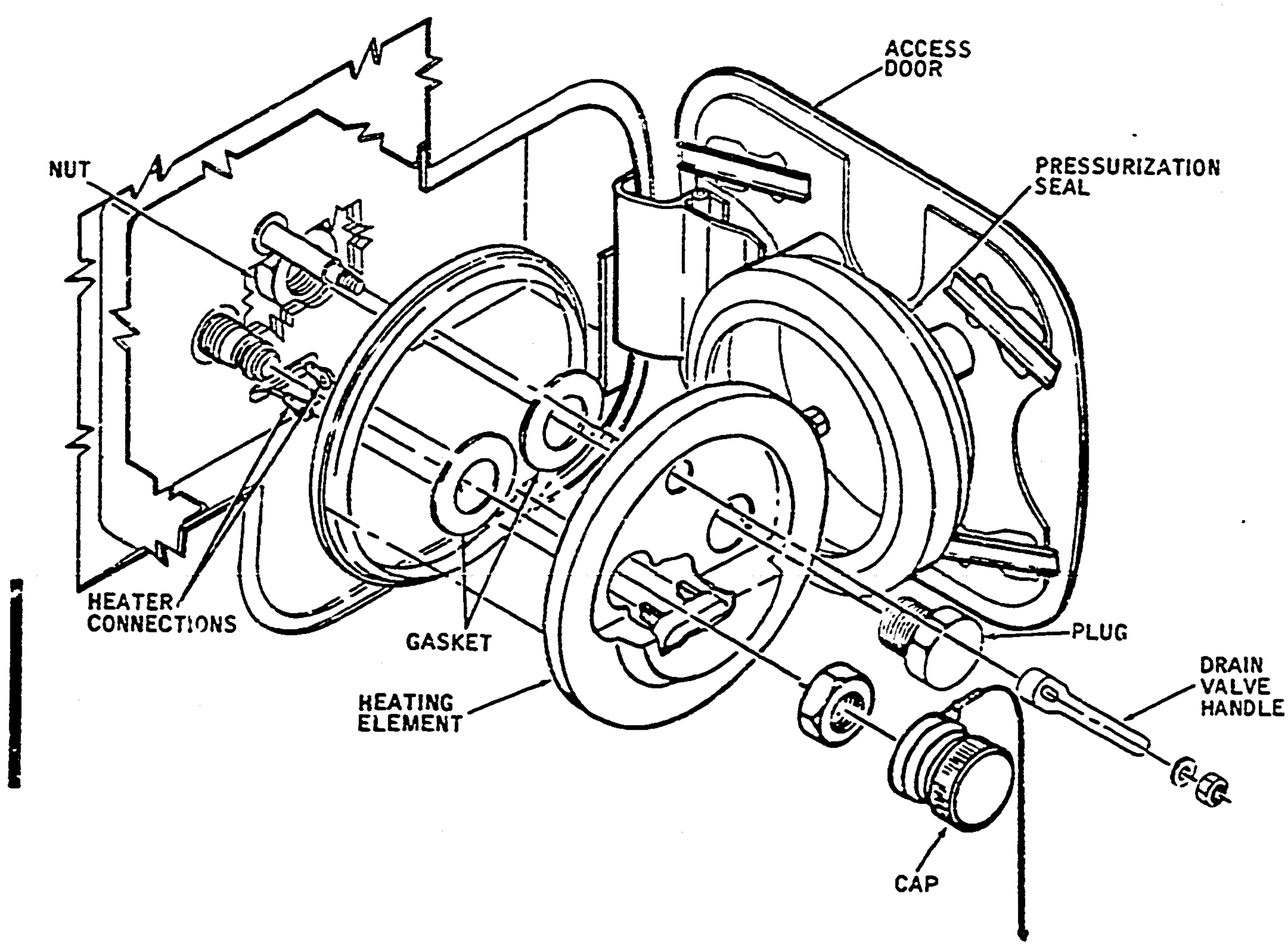
(3) Connect wires to element terminals.

(4) Hold element in place, and install cap retaining plate, nipple and plug mounting nuts.

(5) Install cap on nipple.

(6) Close water service panel heater circuit breaker.





HA2-2014A

Potable Water System Drain Panel Heating
Element -- Installation
Figure 201

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4. Adjustment/Test Potable Water System Drain Panel Heating Element

A. Test Heating Element

(1) Open water service panel heater circuit breaker located on aft cabin electrical panel.

(2) Using dry ice reduce temperature in area of water system drain panel heating element below 18.3 (±5.6) °C (65 (±10) °F).

(3) Close water service panel heater circuit breaker.

(4) Feel heating element and note increase in temperature.

POTABLE WATER SYSTEM DRAIN FITTING HEATER - MAINTENANCE PRACTICES

1. General

A. The potable water system drain fitting heater is located behind the water service panel and surrounds the water system drain fitting. The heater is accessible from inside the aft accessory compartment.

B. Two men are required, one inside the airplane and one outside at the water service panel, for removal/installation of the heater.

2. Removal/Installation Water System Drain Fitting Heater

CAUTION: IF THE WATER SYSTEM CONTAINS WATER, THE DRAIN VALVE HANDLE MUST REMAIN IN THE CLOSED POSITION DURING REMOVAL/INSTALLATION PROCEDURES.

A. Remove Water System Drain Fitting Heater

(1) Open water service panel heater circuit breaker located on aft cabin electrical panel.

(2) Disconnect drain line from fitting.

(3) Remove fitting mounting nut and remove fitting.

(4) Disconnect drain fitting heater wires from water service panel heater terminals.

(5) Remove heater.

B. Install Water System Drain Fitting Heater

(1) Make certain water service panel heater circuit breaker, located on aft cabin electrical panel, is open.

(2) Install heater.

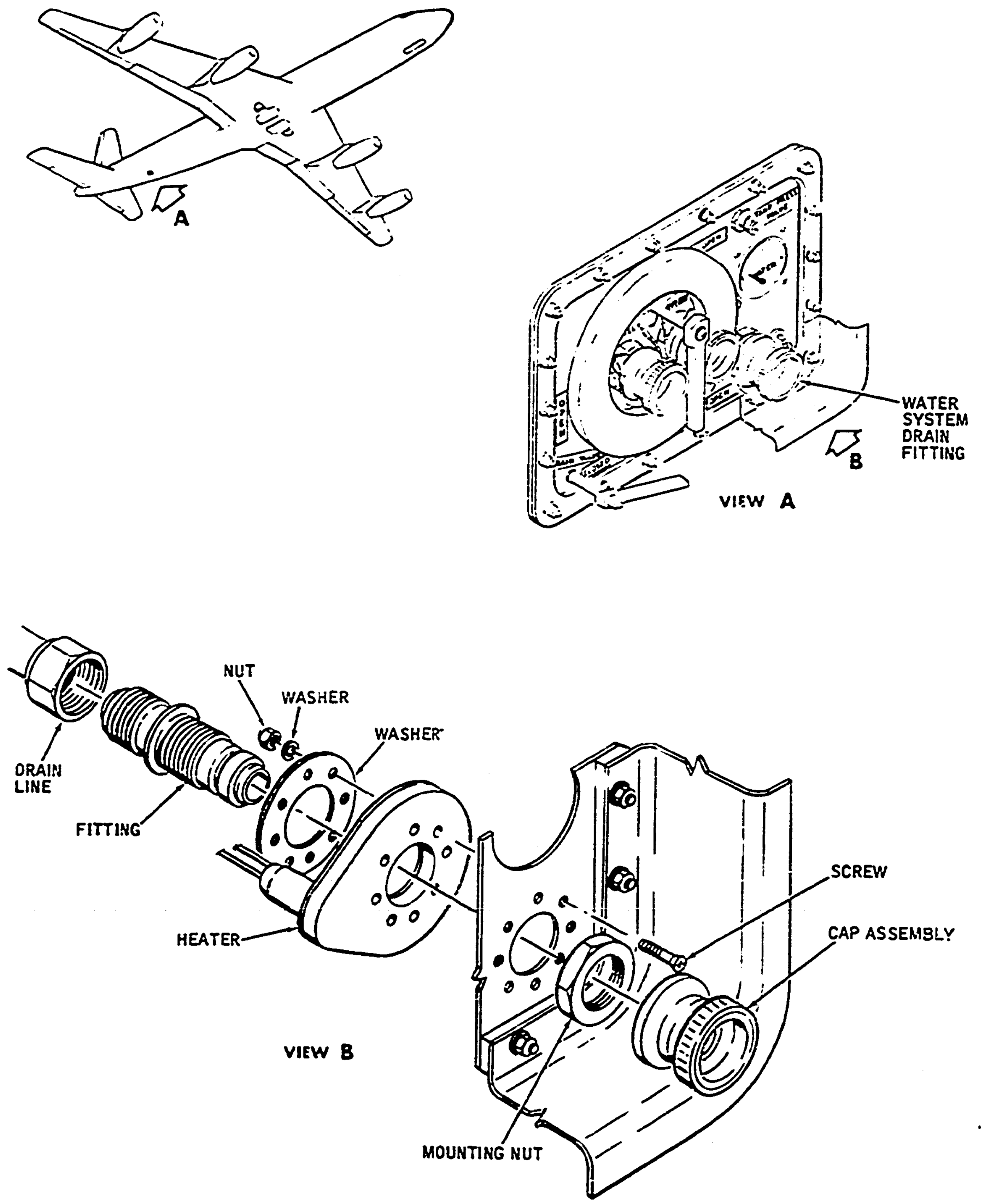
(3) Connect heater wires to water service panel heater terminals.

(4) Install drain fitting.

(5) Connect drain line.

(6) Close water service panel heater circuit breaker.

(7) With electrical power on airplane, check that heater becomes warm.



Potable Water System Drain
Fitting Heater -- Installation
Figure 201

Printed in U.S.A.

WASTE WATER SERVICE PANEL HEATERS - MAINTENANCE PRACTICES

1. General

A. Waste water service panel heaters surround the toilet flush and drain fittings on each waste water service panel. Two panels are located on the lower aft fuselage section, just below the lavatories. One panel is located on the lower right forward section of the fuselage.

B. Two types of heaters are used. The smaller type surrounds the toilet flush fitting. The larger type surrounds the toilet drain fitting. Removal/installation procedures are identical for both types of heater, except as noted.

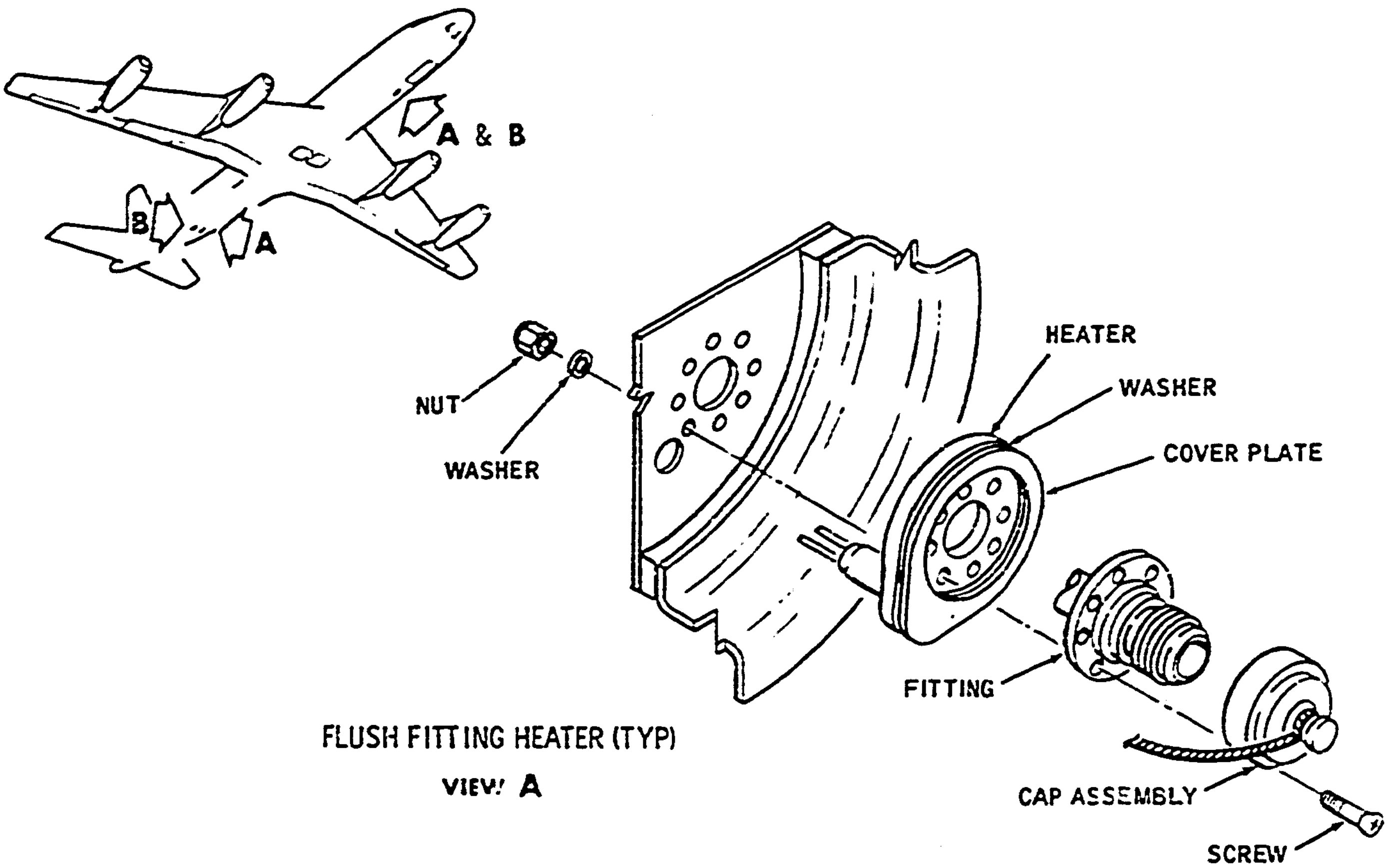
C. Two men are required, one inside the airplane and one outside at the waste water service panel, for removal/installation of heater.

2. Tools and Equipment Required

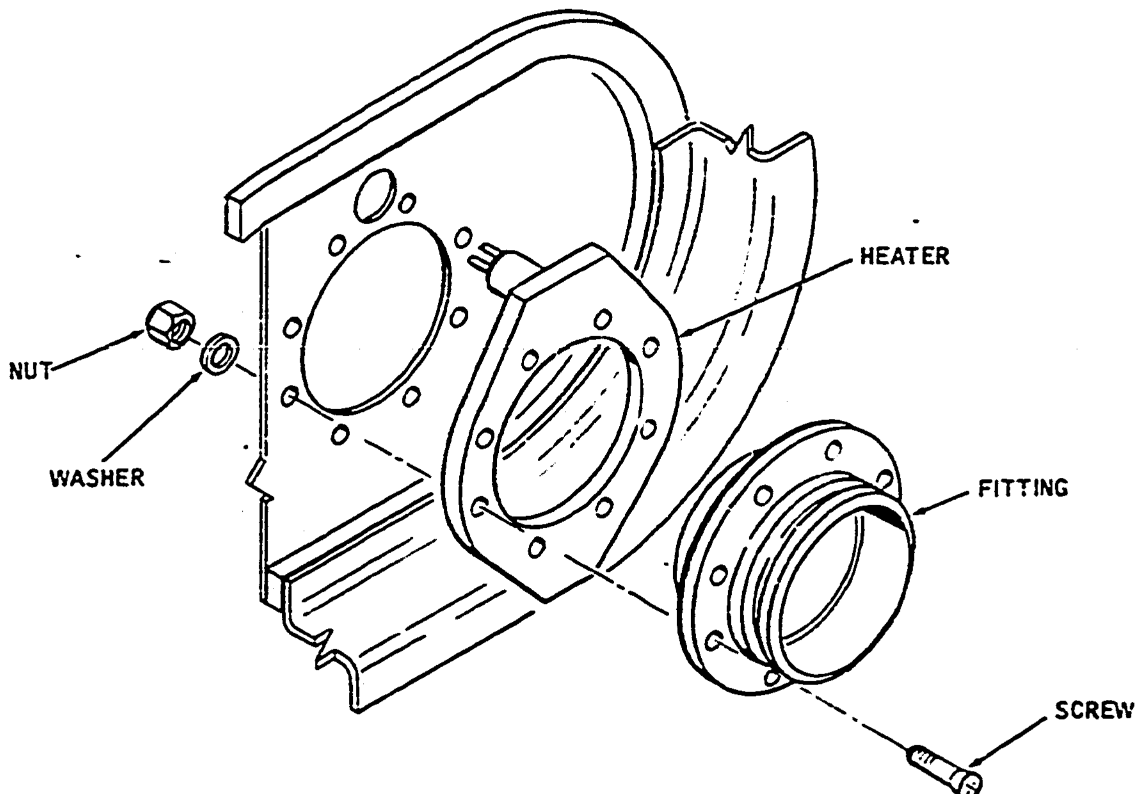
NOTE: Equivalent substitutes may be used instead of the following listed items.

Item	Name	Number	Manufacturer	Use
A	Sealant base	RTV-1016	General Electric Co. Silicone Products Dept.	Seal faying surfaces of heaters.
B	Sealant catalyst	RTV-9910	General Electric Co. Silicone Products Dept.	Mix with sealant base.
C	Silastic adhesive	S-140	Dow Corning Corp.	Cement washer and cover plate to heater.
D	Methyl-ethyl-ketone (MEK)	TT-M-00261	Local	Clean faying surface.

NOTE: Sealant should be mixed immediately prior to use and is mixed 100 parts base to 10 parts of catalyst (by weight).



FLUSH FITTING HEATER (TYP)
VIEW A



DRAIN FITTING HEATER (TYP)
VIEW B

HA2-5923

Waste Water Service Panel Heaters --
Installation
Figure 201

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3. Removal/Installation Waste Water Service Panel Heaters

NOTE: The heaters used on the flush fitting of the waste water service panel and on the drain fitting of the potable water service panel are similar in appearance. Make certain that correct type of heater is to be installed on the corresponding fitting.

A. Prepare Flush Fitting Heater For Installation

(1) Apply uniform coat of adhesive 0.005 to 0.010 inch thick to both sides of washer, and mating faying surfaces of heater and cover plate.

NOTE: Adhesive is to be applied to aluminum surface of heater.

(2) Allow 5 to 10 minutes open time. Position washer on heater and cover plate on washer.

(3) Clamp assembled parts with sufficient pressure to maintain contact without causing excessive squeeze-out of adhesive.

(4) Allow 8 hours cure time at room temperature before handling.

B. Remove Heaters

(1) Open corresponding waste water service panel heaters circuit breaker.

NOTE: The circuit breaker for the aft waste water service panel heaters is located on the aft cabin electrical panel. The circuit breaker for the forward waste water service panel is located on the forward cabin electrical panel.

(2) Make certain that applicable toilet line is drained.

(3) Remove clamp and disconnect hose from fitting.

(4) Disconnect heater electrical wire from adjacent terminal strip.

(5) Disconnect heater electrical wire from ground terminal.

(6) Remove mounting screws and remove fitting and heater from panel.

NOTE: If removing toilet flush fitting heater, the washer and cover plate cemented to the heater should be discarded.

C. Install Heaters

(1) Make certain that applicable waste water service panel heaters circuit breaker is open.

(2) Clean faying surfaces to remove old sealant.

(3) If installing toilet flush fitting heater, check that washer and cover plate are cemented to heater.

(4) Apply sealant to faying surface between heater and panel.

(5) Position heater and fitting on panel and install mounting screws.

(6) Connect one heater electrical wire to adjacent ground terminal.

(7) Connect remaining heater electrical wire to adjacent terminal strip.

(8) Connect hose to fitting.

(9) Close applicable waste water service panel heaters circuit breaker.

(10) With electrical power on airplane, check that heater becomes warm.

DETECTION - DESCRIPTION AND OPERATION

1. Description

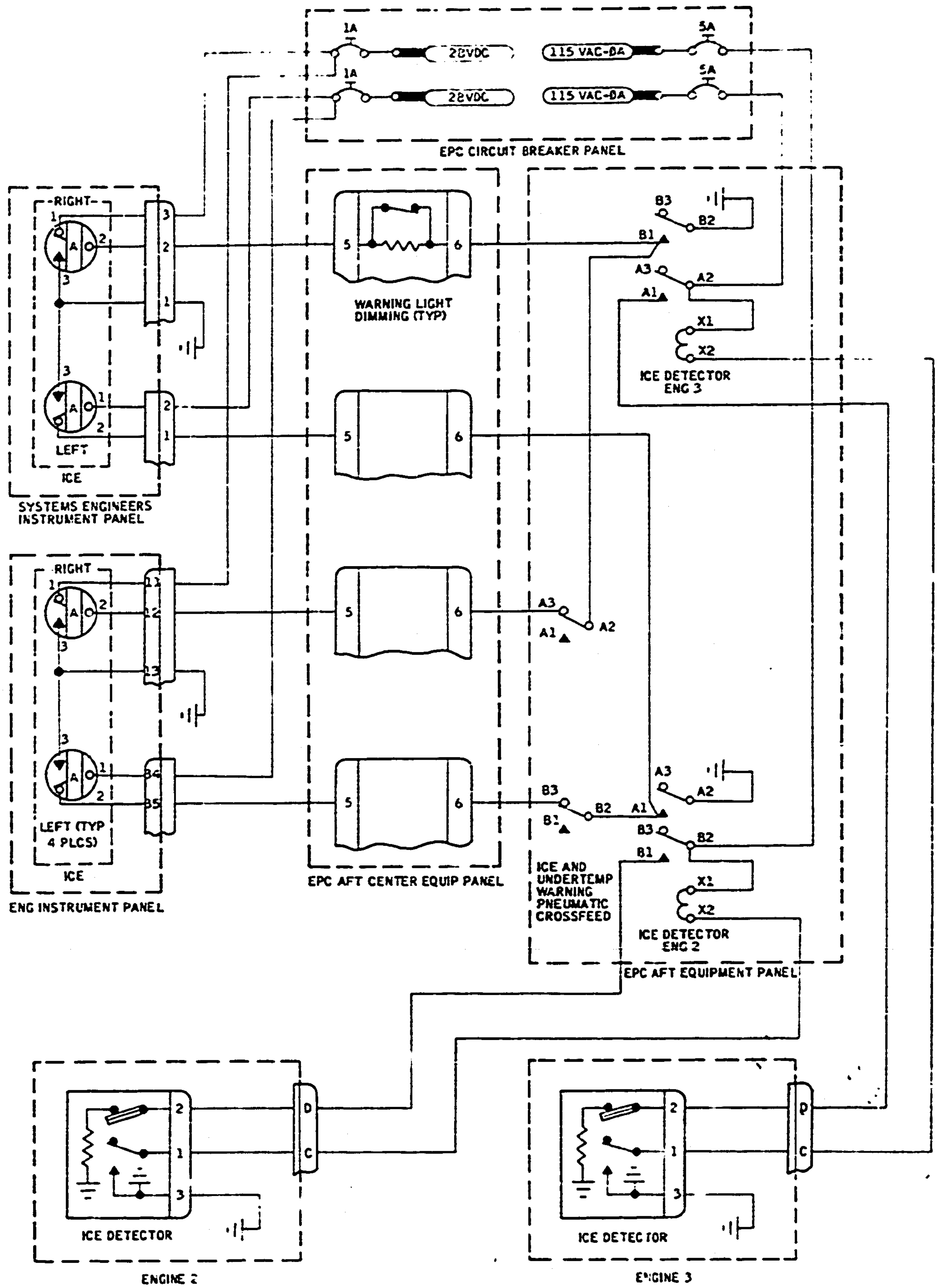
A. The ice detection system detects ice formation in the engine inlet ducts of the inboard engines and indicates to the flight crew the need to operate the anti-icing and deicing systems.

B. The ice detection and indicating light system consists of two ice detectors, one installed in each inboard engine, two ice detector relays, and indicating lights for the pilot and systems engineer. Both lights are dual assemblies; one light in both assemblies indicates for the left ice detector and the other indicates for the right detector.

2. Operation

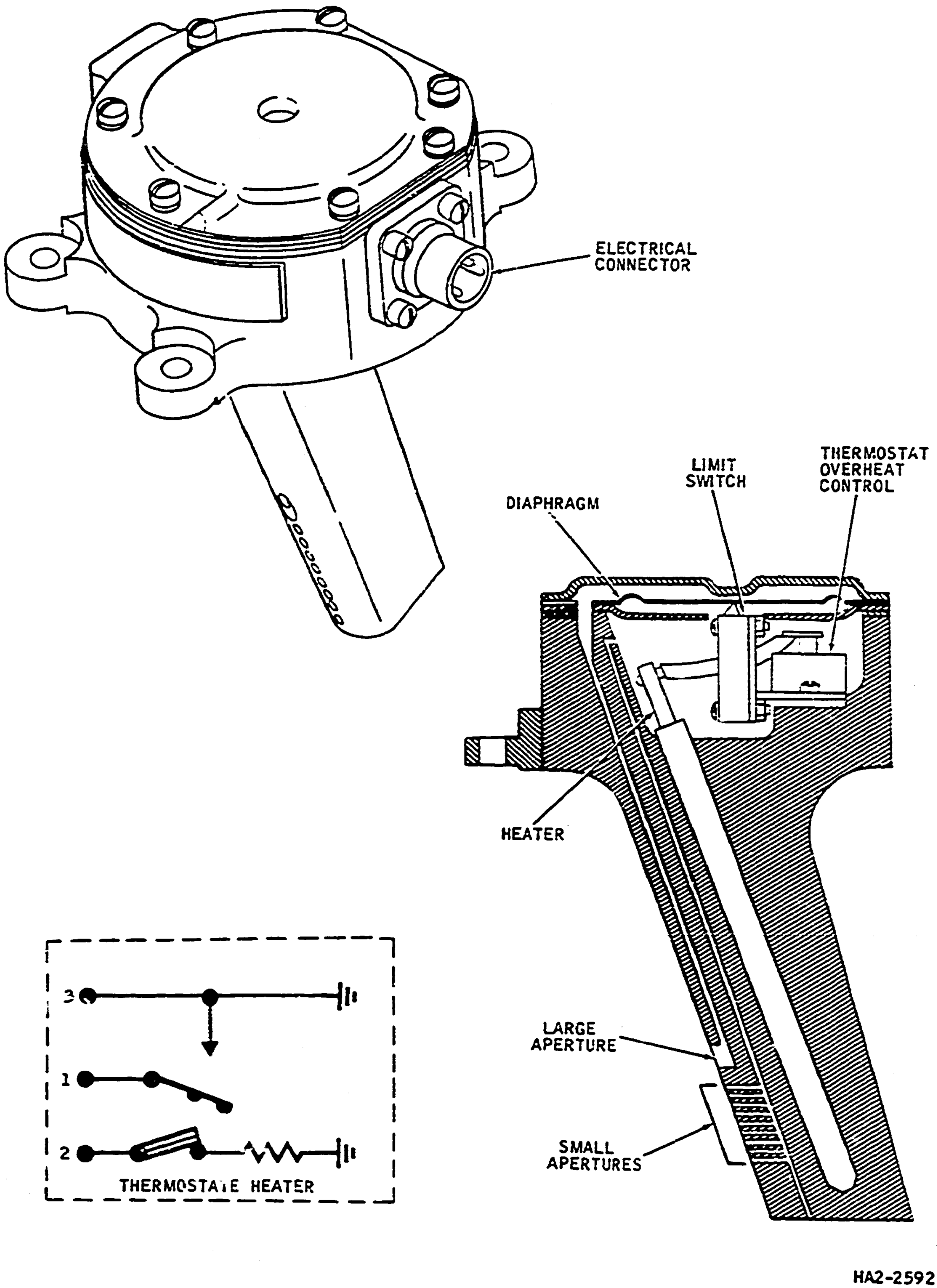
A. The detector assembly is a small airfoil-shaped blade with small apertures along the lower leading edge. The upper or large aperture admits air to the pressure passage that pressurizes the top pressure chamber. The lower aperture consists of small openings that admit air to the detector pressure area under the diaphram. Ice forming along the leading edge of the ice detector will restrict air to a much greater degree along the small openings and, thus, cause a pressure differential that will move the diaphram downward. This motion closes the limit switch and completes the electrical circuit to energize the ice detector relay. This causes the ice indicating lights to come or and supplies a-c power to the heating element.

The heating element melts the ice and removes the ice restriction from the air entrance. The pressure on the diaphram is equalized and the limit switch opens to remove power from the heater and indicating light. The ice detector is then ready to repeat the cycle of operation. The indicating light(s) will continue to go on and off until icing conditions no longer exist, or until the scoops anti-ice switch is placed in the anti-ice position.



HA2-2591

Ice Detection System -- Electrical Schematic
Figure 1



Ice Detector -- Schematic
Figure 2

DETECTION - DESCRIPTION AND OPERATION

1. Description

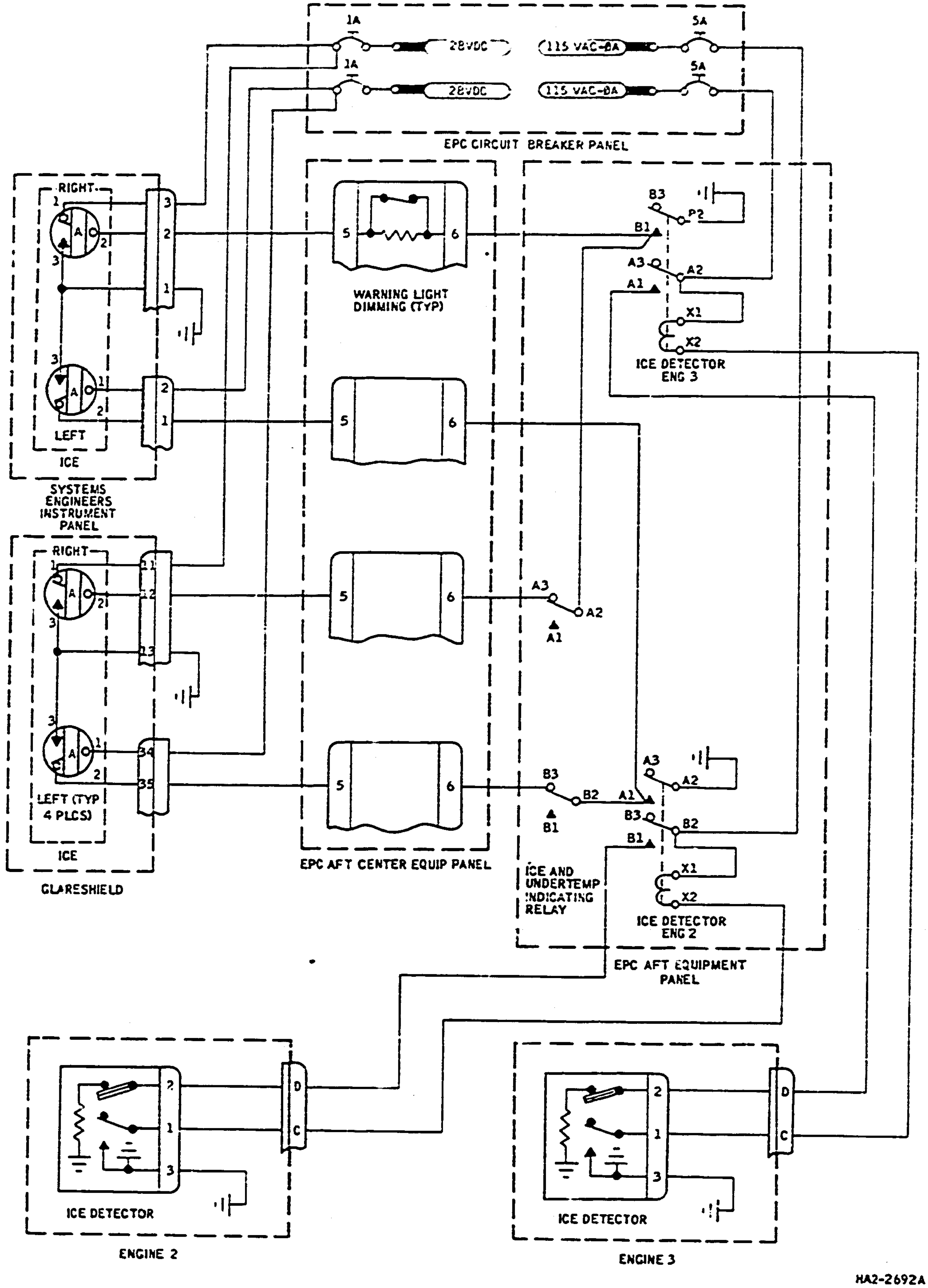
   A. The ice detection system detects ice formation in the engine inlet ducts of the inboard engines and indicates to the flight crew the need to operate the anti-icing and deicing systems.

   B. The ice detection and indicating light system consists of two ice detectors, one installed in each inboard engine, two ice detector relays, and indicating lights for the pilot and systems engineer. Both lights are dual assemblies; one light in both assemblies indicates for the left ice detector and the other indicates for the right detector.

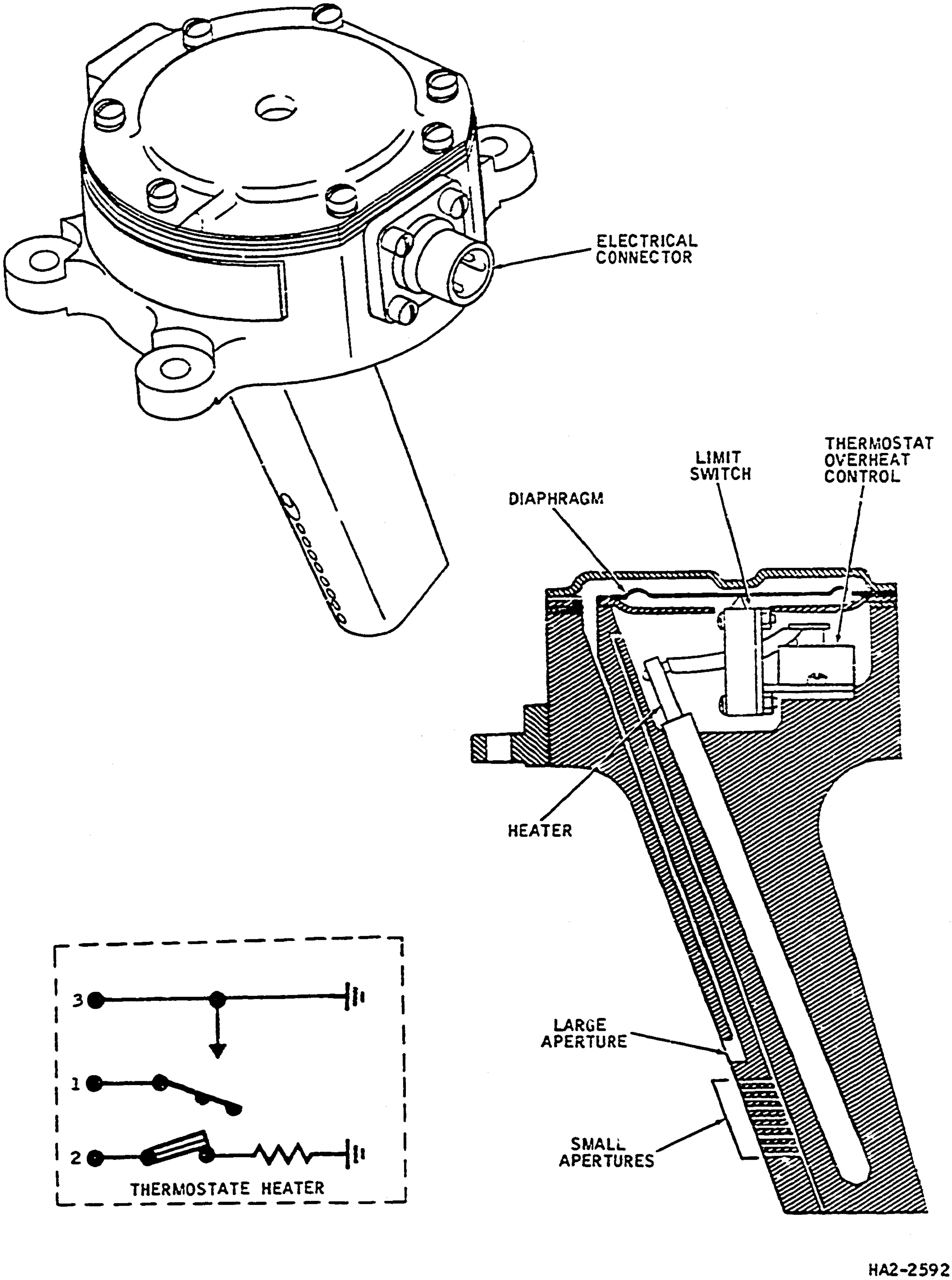
2. Operation

   A. The detector assembly is a small airfoil-shaped blade with small apertures along the lower leading edge. The upper or large aperture admits air to the pressure passage that pressurizes the top pressure chamber. The lower aperture consists of small openings that admit air to the detector pressure area under the diaphram. Ice forming along the leading edge of the ice detector will restrict air to a much greater degree along the small openings and, thus, cause a pressure differential that will move the diaphram downward. This motion closes the limit switch and completes the electrical circuit to energize the ice detector relay. This causes the ice indicating lights to come on and supplies a-c power to the heating element.

   The heating element melts the ice and removes the ice restriction from the air entrance. The pressure on the diaphram is equalized and the limit switch opens to remove power from the heater and indicating light. The ice detector is then ready to repeat the cycle of operation. The indicating light(s) will continue to go on and off until icing conditions no longer exist, or until the scoops anti-ice switch is placed in the anti-ice position.



Ice Detection System -- Electrical Schematic
Figure 1



Ice Detector -- Schematic
Figure 2

DETECTION - MAINTENANCE PRACTICES

1. General

A. The ice detection indicating lights are located on the systems engineers lower right instrument panel and on the pilots engine instrument panel. The ice detectors are located in the nose cowl bulkheads of engines 2 and 3.

2. Tools and Equipment Required

A. A water manometer and sensitive pressure regulator that can apply and measure an air pressure of 8 (+0.5, -0) inches of water (gage pressure) is used to test the ice detection system.

3. Adjustment/Test Detection System

A. Test Detection System

(1) Open engine starters circuit breaker, located on battery bus section of EPC circuit breaker panel.

(2) Place following flight compartment switches in indicated positions:

(a) Starter and ignition arming switch -- off

(b) Scoops anti-icing switch -- off

(3) Apply air pressure of 8 (+0.5, -0) inches of water (gage pressure) to large hole in ice detector located in intake of No. 2 engine. Check that both left ice indicating lights come on.

(4) Place scoops anti-icing switch in anti-ice position. Check that left ice indicating lights go off.

(5) Test ice detector for definite rise in temperature.

WARNING: DO NOT TOUCH AN ENERGIZED DETECTOR HEATER.

(6) Place scoops anti-icing switch in off position. Check that left ice indicating lights come on.

(7) Remove pressure from left ice detector. Check that left indicating lights go off.

CAUTION: ALTHOUGH THE ICE DETECTOR HAS A THERMAL PROTECTOR, DO NOT HOLD THE PRESSURE ON THE ICE DETECTOR UNIT LONGER THAN 5 SECONDS AS AN ADDITIONAL PRECAUTION TO PREVENT OVERHEATING.

(8) Apply air pressure of 8 (+5.0, -0) inches of water (gage pressure) to large hole in ice detector located in intake of No. 3 engine. Check that both right ice indicating lights come on.

(9) Place scoops anti-icing switch in anti-ice position. Check that right ice indicating lights go off.

(10) Test detector for definite rise in temperature.

WARNING: DO NOT TOUCH AN ENERGIZED DETECTOR HEATER.

(11) Place scoops anti-icing switch in off position. Check that right ice indicating lights come on.

(12) Remove pressure from right ice detector and check that right ice indicating lights go off.

(13) Close engine starters circuit breaker, located on battery bus section of EPC circuit breaker panel.

DETECTION - MAINTENANCE PRACTICES

1. General

   A. The ice detection indicating lights are located on the systems engineers lower right instrument panel and on the pilots glareshield. The ice detectors are located in the nose cowl bulkheads of engines 2 and 3.

2. Tools and Equipment Required

   A. A water manometer and sensitive pressure regulator that can apply and measure an air pressure of 8 (+0.5, -0) inches of water (gage pressure) is used to test the ice detection system.

3. Adjustment/Test Detection System

   A. Test Detection System

      (1) Open engine starters circuit breaker, located on battery bus section of EPC circuit breaker panel.

      (2) Place following flight compartment switches in indicated positions:

         (a) Starter and ignition arming switch -- off

         (b) Scoops anti-icing switch -- off

      (3) Apply air pressure of 8 (+0.5, -0) inches of water (gage pressure) to large hole in ice detector located in intake of No. 2 engine. Check that both left ice indicating lights come on.

      (4) Place scoops anti-icing switch in anti-ice position. Check that left ice indicating lights go off.

      (5) Test ice detector for definite rise in temperature.

      WARNING: DO NOT TOUCH AN ENERGIZED DETECTOR HEATER.

      (6) Place scoops anti-icing switch in off position. Check that left ice indicating lights come on.

      (7) Remove pressure from left ice detector. Check that left indicating lights go o.

      CAUTION: ALTHOUGH THE ICE DETECTOR HAS A THERMAL PROTECTOR, DO NOT HOLD THE PRESSURE ON THE ICE DETECTOR UNIT LONGER THAN 5 SECONDS AS AN ADDITIONAL PRECAUTION TO PREVENT OVERHEATING.

(8) Apply air pressure of 8 (+5.0, -0) inches of water (gage pressure) to large hole in ice detector located in intake of No. 3 engine. Check that both right ice indicating lights come on.

(9) Place scoops anti-icing switch in anti-ice position. Check that right ice indicating lights go off.

(10) Test detector for definite rise in temperature.

WARNING: DO NOT TOUCH AN ENERGIZED DETECTOR HEATER.

(11) Place scoops anti-icing switch in off position. Check that right ice indicating lights come on.

(12) Remove pressure from right ice detector. Check that right ice indicating lights go off.

(13) Close engine starters circuit breaker, located on battery bus section of circuit breaker panel.

ICE DETECTORS - MAINTENANCE PRACTICES

1. General

   A. The ice detectors are located, one each, in engine No. 2 and engine No. 3. Access to the detectors is through engine access door No. 39. Removal and installation procedures for the left and right ice detectors are identical.

2. Removal/Installation Ice Detectors

   A. Remove Ice Detector

      (1) Open applicable engine ice detector circuit braker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

      (2) Disconnect and cap electrical connector from ice detector.

      (3) Remove detector from engine air inlet duct.

   B. Install Ice Detector

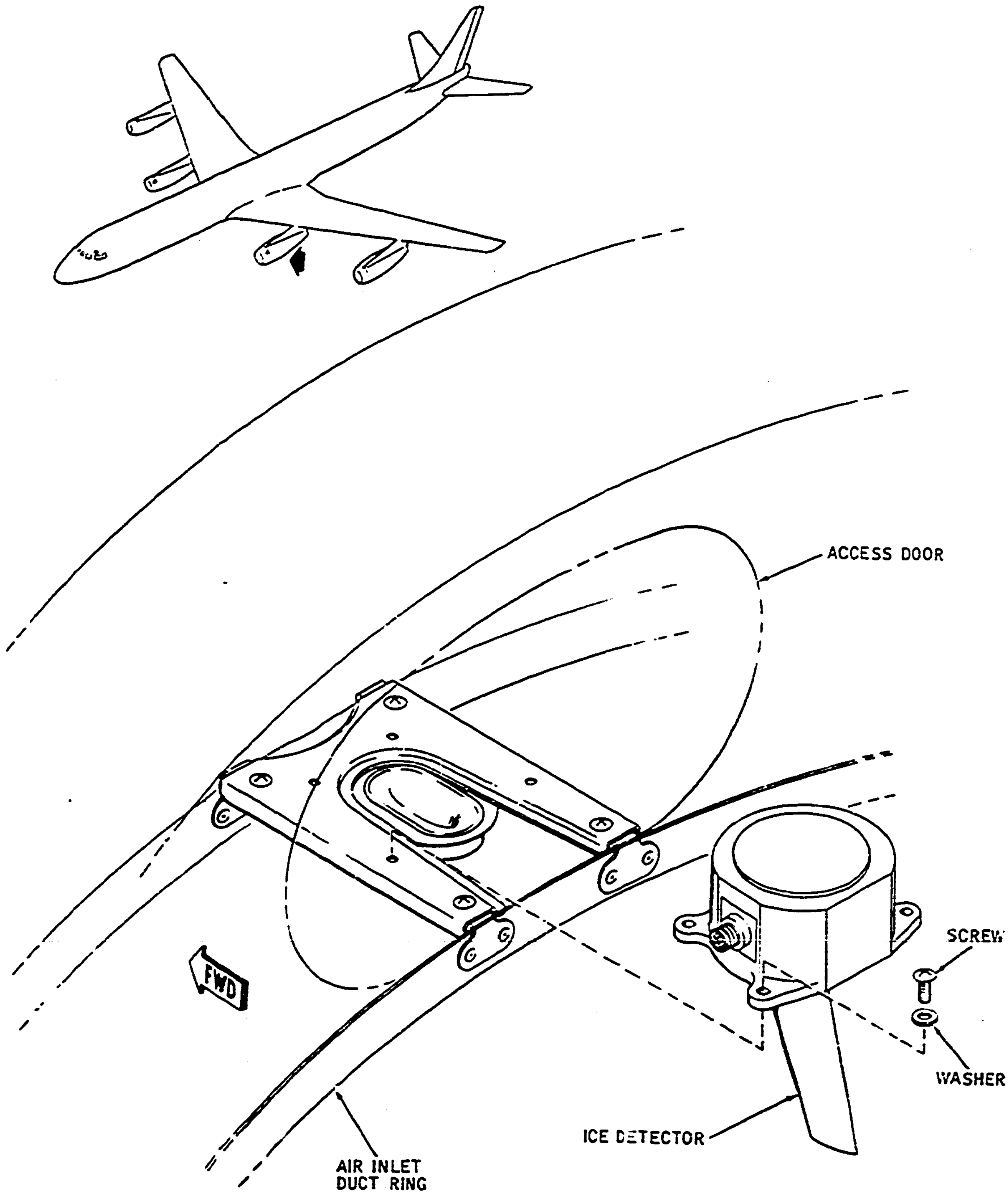
      (1) Position ice detector in engine air inlet duct and install attach screws.

      NOTE: Make certain that rubber seal is installed on ice detector unit before detector is inserted in air inlet duct.

      (2) Connect electrical connector to detector.

      (3) Close applicable engine ice detector circuit breaker, located on heat, vent, and ice protection (ac bus) section of EPC circuit breaker panel.

      (4) Test ice detector by performing detection system test procedures (see 30-80-0).



HA2-2618

Ice Detector (Typical) -- Installation
Figure 201